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AN AMERICAN WELCOME.

Our visitors from abroad have been arriving in goodly numbers the past ten days. Last week some fifty Italian engineers, members of the Associazione Elettrotecnica Italiana, and some of them Government or official delegates, reached these shores, with the object of going to St. Louis on the circular tour arranged by the American Institute of Electrical Engineers. This week, by the time these lines appear in print, a party of seventy-five, representing the Institution of Electrical Engineers of Great Britain, will have landed in Boston. Meantime other friends from Germany, Austro-Hungary, France, South America and other lands have come to port, and to all a hearty and cordial welcome has been extended. The hospitable preparations are now taking effect in deeds, and we hope and believe nothing will be left undone to promote the comfort and happiness of our guests, and to make them wholly at home in America. The united Anglo-Italian party now in Boston will enjoy the functions of which note is elsewhere made, and then move on to New York, where the Italian contingent alone has for some days prior to its trip to Boston been sightseeing and making the very best of some very charming weather. It is indeed to be devoutly prayed that the recent weather—cool, crisp and sunny—may endure throughout September. It will add considerably to the pleasure of the circular tour and other incidents, and make the inevitable fatigue of long travel and constant excitement much less, as well as bearable. The past week in New York has, indeed, been an example of what can be easily accomplished, if the skies be propitious, in covering a large area and seeing objects of interest at widely scattered points, from early dawn till late at night. Our Italian guests are still "as fresh as paint" and we trust good health will be the lot of all now coming here to see what electricity has done in the United States, and to put themselves at the St. Louis Congresss in touch with the electrical thought and knowledge of all the rest of the world.

ALTERNATING-CURRENT PHENOMENA.

Elsewhere we print the concluding portion of an article by Mr. Lamar Lyndon, treating, from the physical standpoint, the principles of alternating current phenomena and their relations, and which exposition we commend to all of our readers. To those who have not had an opportunity to make a systematic study of alternating currents it will furnish an admirable introduction to the subject; and even adepts in academic alternating-current theory will find in the article much to interest them. We believe we echo the thought of all students and of most engineers in expressing a hope that the day is not far distant when the exposition of alternating-current phenomena will be placed upon a basis widely different from that of the past. The time-honored method appears to date back to the classical paper of Joubert, printed in 1881. If the experiments forming the subject of this paper had been made, not on a Siemens machine without iron in the field and thus giving a plotted curve of e.m.f. nearly approaching a sine curve, but on a machine giving a flat or peaked curve, perhaps the whole process of development of alternating current mathematical analysis might have proceeded along quite different lines. As it was, the analytical discussion in the final pages of the paper set the pace, and the mathematical method there established appears to have served as almost the entire basis of subsequent development. It is true that about ten years or more ago there was

a reaction, which manifested itself by recourse to graphical methods. This, however, was to the student and engineer like an escape from Scylla only to encounter the whirls of Charbydis; for the spider-web constructions of this method carried to its full consequences are even more repellant than the corresponding array of mathematical symbols in the analytical method.

The truth appears to be that both the elaborate analytical and graphical methods are unsuited for practical instruction and use on account of the very generality which causes them to appeal to the academic mind. It is rarely that the engineer has need to know all of the consequences of a proposition between the limits of zero and infinity. A general system of development may be of service to a few specialists, and its study a means to develop the mind and broaden the views of the student, and therefore of special value from a purely educational standpoint; but for the best understanding of phenomena their exposition should be held as near to the concrete as possible. We believe it to be entirely feasible to so simplify alternating-current exposition and calculation in their more practical aspects, that almost every one of the phenomena involved can be rendered clear to a mind without systematic training; and also to make them subject to calculation by methods requiring scarcely an elementary knowledge of algebra. For example, by the use of the right-angled triangle most problems involving inductance or capacity, or both, in series, may be easily seized in principle and simply calculated numerically; and by means of an oblique-angled triangle and the aid of a simple table of trigonometrical values, one without knowledge of either algebra or trigonometry can solve problems involving inductance or capacity, or both, in parallel. What such simplification means is evident if one recalls the complications of analytical or graphical methods applied to these solutions. But, above all, the simpler method keeps in sight the underlying physical conceptions, which is not at all true of analytical methods and only very slightly true of the usual general graphical methods.

FAULTS IN TELEPHONE CABLES.

While faults on telephone circuits have been decreased numerically by the grouping of many wires within a metallic enclosure affording protection from moisture and mechanical injury, the removal of faults which develop in such cables has been rendered much more difficult by reason of the lack of accessibility of the individual circuits. The increased difficulty is due not so much to greater gravity of faults, or to the added trouble experienced in placing the circuits again in operation, as to the impossibility of directly determining the position of the faults by inspection. The various applications of Ohm's law to divided and series circuits containing known and unknown resistance, have resulted in a great number of methods for electrically determining the relative resistances to the fault and thus finding the distance thereto as desired.

The article by Mr. H. B. Stabler, published in our last issue, describes a very simple method, involving the use of a portable millivoltmeter, by means of which a "ground" connection between one circuit and a cable sheath may be located. Current is passed through the fault, and its direction of flow in the outer sheath being observed at various places along the cable, the position of the "ground" is determined. The method eliminates the necessity for calculation of the resistances of the cable sections, and where the cable is accessible a well-defined "ground" may be accurately located. The method is similar in many respects to one proposed by Mr. T. W. Varley for locating faults in cables for light and power work (Vol. XXXIX, p. 32). In the Varley method the cable is explored with a magnetic needle, while the direct current which is introduced is interrupted for definite periods. The method described by Mr. Stabler does not involve the use of special apparatus, and since it can be applied by one man—the repair man—it possesses the advantage of extreme simplicity. The second method outlined in the article is somewhat more complicated, and while conditions may arise in which its use would be attended with success, it is not apparent under what circumstances both ends of a single cable in commercial telephonic equipments would be available for the purpose of inserting testing instruments in a manner to allow of their being observed simultaneously.

ALTERNATING-CURRENT MEASUREMENTS WITH DIFFERENTIAL TELEPHONES.

In the current number of the *Physical Review,* Professor Ho again calls attention to the value of the differential telephone as an alternating-current measuring instrument, on which subject Prof. Ho has made several contributions to these columns. In emphasizing the value of the differential telephone, Prof. Ho enunciates an interesting theorem that, if not new, is at least not known widely. It is that if two insulated wires are wound side by side, so as to form an induction coil in which the resistance and inductance of the two windings are equal, then the mutual inductance of the windings will, of course, be equal to the self-inductance of either. Under these conditions, when equal and opposite alternating currents flow through the windings, the effects of self-inductance in each winding are cancelled by the effects of mutual inductance, so that the windings behave as though non-inductive, or possessing only ohmic resistance. This is a valuable property in a differential telephone, since it enables a non-inductive shunt to be applied to either winding, without introducing inductive error in the multiplying power of the shunt.

The above theorem becomes evident when applied to an ordinary transformer with equal numbers of primary and secondary turns, i. e., a "level" transformer or one whose ratio of transformation is unity. If we connect the primary and secondary windings of such a transformer in series, so as to be magnetically in opposition, the apparatus will behave like a non-inductive resistance, except for the stray field or magnetic leakage in the coils, which will produce some reactance. The theorem may be even extended to cover the case of alternating currents that are neither equal nor opposite in phase. For if two such equally inductive coils be included (reversed) in any pair of branch circuits from a source of alternating e.m.f., the coils will behave as though devoid of inductance, and as adding their resistances only to their respective branches. In the measurement of small inductances accompanied by low resistance, Prof. Ho recommends connecting the unknown and the adjustable known inductances in series with the telephone windings in shunt to them respectively. On the other hand, when the impedance of the coil, whose inductance is to be measured, is large, the known and unknown inductances may be connected in parallel through the respective windings of the telephone. For the comparison of condensers, the multiple connection last described has to be employed. It is said that with 500 volts of alternating e.m.f., capacities as low as one-millionth of a microfarad can be measured. This is just about one abstatfarad, or the capacity of a sphere in free space having a radius of one centimeter; or again, the capacity of an air condenser whose plates are discs 2 cm. in radius, separated by a distance of 1 cm. Such a capacity is so small that the difficulty in measuring it is the difficulty of eliminating the extraneous capacity of connections.

REGULATION OF ALTERNATORS.

If from the internal generated e.m.f. of an alternator there be subtracted, in proper phase relation, the e.m.f. due to the flow of current through the armature impedance, the delivered terminal e.m.f. of the machine will be determined. The internal generated e.m.f. is in general not the voltage obtained when the machine is operated without load, since the armature current, unless it has an appreciable leading component, materially affects the magnetism cut by the armature inductors. The magnitude of the effect produced by the armature current upon the field magnetism depends more upon the mechanical position in space of the conductors when the current flows, than upon the value of the current itself. With sinusoidal waves of current, the magnetomotive force of the armature current under a given load is, for a polyphase armature, more or less constant in value and mechanical position, fluctuating in value a maximum of 29 per cent. for a two-phase and 13 per cent. for a three-phase winding, and vibrating in position with a frequency depending upon the number of phases. The flux produced by this magnetomotive force is relatively inappreciable when its general direction is immediately between the field poles, but it assumes a large value when it is in front of a field pole. The mean position of the armature magnetomotive force with reference to the field poles is determined by the time phase position of the current—that due to a lagging or leading current tending, respectively, to weaken or strengthen the poles, while a current in time phase with the e.m.f. produces merely a distorting effect. When the effective ampere-turns of the armature current are known and the mechanical position of the magnetomotive force is found, the internal generated e.m.f. of the alternator may be ascertained from the value of the resultant flux in the field poles.

The armature impedance is made up of two components—a resistance of constant value and an inductive reactance varying with the position of the armature. The inductance is due to the magnetic lines which locally surround the individual conductors, and it, therefore, depends for its value upon the number of conductors bunched together, the current flowing and the permeance of the magnetic path. It is on account of the variation of the permeance that the inductance is not constant. When the slots occupied by the conductors pass in front of the field poles, the permeance is increased by reason of the mass of iron substituted for the air in the path of the magnetic flux. Thus, in a given armature, the inductance has a value varying synchronously with the motion of the armature. The mechanical phase of the permeance is only slightly affected by any change in phase of the armature current, but the effective value of the inductance depends greatly upon the position of the armature when the maximum current flows. Since when a leading current is drawn through an inductive reactance, the terminal pressure is raised, and in an alternator a leading current tends to excite the fields and thus to raise the internal generated e.m.f., the armature reaction and the inductive reactance are frequently treated as a single composite quantity termed the "synchronous reactance." It is seen that the synchronous reactance is composed of a magnetomotive force effect and an electromotive force effect, each of which possesses a cyclic variation with the motion of the armature.

It has frequently been pointed out that the synchronous reactance found by short-circuiting the armature when driven at full speed under properly weakened field is not the true operating reactance, since the two effects noted above vary with the degree of saturation of the core material, and consequently the effects cannot, without error, be combined as one. On page 369 of this issue will be found an article by Mr. C. A. Canfield in which he describes methods for calculating the value of the armature reaction and inductive reactance and for treating the quantities when so found. A fact which assumes prominence in all such work is that, when dealing with magnetic circuits, equations can be depended upon only when the constants have been experimentally determined. No simple method can lay claim to absolute accuracy when dealing with a problem containing so many inter-related variables as are connected with the regulation of alternators. The method outlined by Mr. Canfield, however, possesses the happy combination of being easily understood and simply applied, while giving results sufficiently accurate for purposes of design.

THE SILVER VOLTAMETER.

Since our international ampere is defined concretely in terms of the rate of depositing silver in a silver coulombmeter, the importance of studying the range of variation in such deposition under different conditions needs no demonstration. Dr. Guthe publishes the result of a research on this subject in the August number of the *Physical Review*. He shows that when one and the same silver coulombmeter is employed by the same observer successive measurements of the rate of deposition of silver per coulomb, or per ampere-hour, often agree to 1 part in 5,000, or even to 1 part in 10,000. This is a relatively high degree of precision, and more than is necessary for existing practical requirements. On the other hand, if different forms of the silver coulombmeter are used at different times by different observers, the results differ by as much as 1 part in 500, and the mean result may be said to be in doubt by 1 part in 1,000, which is a very appreciable uncertainty from an industrial standpoint. Part of this uncertainty is attributable, however, to differences between the Clark cells, which in all these measurements became standards of reference, and the e.m.f. of which affected the results.

Taking the various forms of the silver coulombmeter that have been suggested, they may be divided into two classes, namely, the Leduc type and the Richards type. The latter is characterized by a porous cup around the anode, and means for preventing the solution around the anode from diffusing to the cathode. The Richards type of bath gives less deposit than the Leduc type by about 1 part in 2,000. The Richards type is recommended as the more reliable and as giving the more nearly correct rate of deposition. With current strength varying between 0.5 and 1.5 amp., Dr. Guthe found that three different varieties of the Richards type of bath agreed within 1 part in 10,000. Taking the Clark cell e.m.f. as 1.434 volts, the electrochemical equivalent of silver arrived at as the result of the research is 1.11683 milligrams per coulomb. This agrees very closely with the results of Carhart and of Kahle. If the filter-paper type of coulombmeter be made the basis, then the result would be 1.11736 milligrams per coulomb. On the other hand, if the electrochemical equivalent of silver be taken as 1.118 milligrams per coulomb, virtually as defined by the Chicago Congress and the United States law, then the e.m.f. of the Clark cell at 15° C. would be 1.4325 international volts on the basis of the Richards coulombmeter, and 1.4332 international volts, on the basis of the filter-paper coulombmeter.

The result of the research made by Dr. Guthe seems, therefore, to be either that the electrochemical equivalent of silver adopted by the Chicago Congress is about 1 per thousand too large, or that the value of the e.m.f. of the Clark cell adopted by the Congress is about 1 per thousand too large. The question is, Which should be corrected? It is more important to maintain international agreement in this matter than to strain after individual national accuracy. Supposing that all the civilized countries adopt the same error of, say, 1 per thousand, the consequence of the error will not be nearly as serious as if some countries were to adopt the correct value and the others the incorrect value, even assuming that absolute accuracy were obtainable.

Visit of European Electrical Engineers.

The general facts as to the present visit of European electrical engineers to the United States to attend the International Electrical Congress at St. Louis have already been set forth several times in these pages, and do not need recapitulation. The arrivals "in bulk" began last week, when the delegation of the Associazione Elettrotecnica Italiana arrived on the *Princess Irene* and *Deutschland,* on August 24 and 25. The party is made up as follows:

Prof. Moisè Ascoli, president, and wife; Prof. Guido Grassi, past-president; Prof. Luigi Lombardi, vice-president; Camillo Albino Curti, member of council; Prof. Ferdinando Lori, member of council; Amatore Maffezzini, Edoardo Ambrosano, Prof. Ugo Ancona, Giovanni Barosi, Carlo Barzano, C. Vincenzo Brazzola, Carlo Caminada, Alfonzo Carelli, Nicostrato Castellini, Filippi Cavalieri, Filippo Danioni, Ascanio Dumontel, Dr. William Dunn, Edoardo Egger, Prof. Gino Fano, Luigi Galimberti, Dr. Ettore Gamba, Luigi Gianetti, Gian Teodoro Giorgetti, Francesco Giudice, Emanuele Jona, Gerolamo Merlini, Aurelio Monteverde, Arnaldo Odazio, Augusto Pancaldi, Antonio Pesenti, Alberto Picchi, Alberto Pirelli, Luigi Pizzi, Eugenio Prandoni, Emilio Rava, Luigi Robbo, Alberto Rubini, Ulderigo Segre, Giuseppe Stramezzi, Gianfranco Tosi, Achille Venzaghi. Prof. Ascoli is accompanied by his wife. He and Messrs. Lombardi and Maffezzini are official delegates of the Italian Government to the Congress.

A separate programme of entertainment for the Italian visitors was arranged and carried out by the local New York committee of the Associazione Elettrotecnica Italiana. The members of this committee are J. W. Lieb, Jr., chairman; C. Facciolo, C. O. Mailloux, P. Torchio and E. Soleri. The programme extended from Wednesday, August 24, the day of the arrival of the first part of the Italian delegation, until Friday, September 2, when the entire Italian party reached Fall River en route for Newport and Boston. The chief items of the programme, which was printed in English and Italian editions, were a reception by the American Institute of Electrical Engineers at the Waldorf-Astoria on Thursday, August 25, a visit to Coney Island over the Brooklyn Rapid Transit system on Friday, August 26; a trip up the Hudson River to West Point, by Albany Day Line, and review of the cadets on parade, the trip being given by the New York reception committee of the A. I. E. E.; a banquet at the Savoy, presided over by Mr. Torchio, attended by the Italian Ambassador, and given by the Italian Chamber of Commerce and the Dante Alighieri Society on Sunday, August 28; a visit to the New York shops of the Western Electric Company, by courtesy of Mr. H. B. Thayer, and to the Chelsea exchange of the New York Telephone Company, where the party was received by General Manager U. N. Bethell and Mr. Renouard; lunch at Simpson, Crawford & Co.'s department store, a special exhibition by the New York Fire Department, and a visit to the Stevens Institute of Technology, on Monday, August 29; an automobile ride by courtesy of the New York Edison Company and inspection of the outer park system of New York City, the Botanical and Zoological Gardens, and an "al fresco" dinner at the Claremont Hotel, Riverside Drive, given by Mr. J. W. Lieb, Jr., on Tuesday, August 30; a visit to the Edison Laboratory, and to the Crocker-Wheeler Works, at Ampere, N. J., with lunch at the latter place, on August 31; a visit to the Electrical Testing Laboratories, with luncheon, on Thursday, September 1; a visit to Fall River to one of the cotton factories, on Friday, September 2, when the party will also stop at Newport, R. I.

Following is a list of members of the British Institution of Electrical Engineers who will be the guests of the A. I. E. E. on its circular tour. President R. Kaye, Gray and Secretary G. C. Lloyd arrived on the *Celtic* Saturday, August 27. The main party will arrive at Boston, Friday morning, September 2: R. Kaye Gray, president; R. E. Crompton, Lieut.-Col., C.B., past-president; Prof. John Perry, past-president, with Miss A. M. Perry and Miss A. Stower; Dr. R. T. Glazebrook, member of council; F. E. Gripper, member of council; Robert Hammond, member of council, and Miss Hammond; H. E. Harrison, delegate; W. Duddell, hon. secretary to Institution delegation; A. F. T. Atchison, George Balfour, R. S. Ball, W. A. Barnes, Mr. and Mrs. D. Bates, G. Conrad Blair, Mr. and Mrs. John Connolly, Prof. and Mrs. J. D. Cormack, J. R. Dick, James Edgar, Mr. and Mrs. R. S. Erskine, W. P. J. Fawcus, H. Feilden, J. A. Foster, Y. Geipel, W. A. Harris, C. C. Hawkins, M. Hayashi, Mr. and Mrs. Thomas Hesketh, O. Higman, F. Hope-Jones, M. Jennison, W. N. Kernot, F. C. Kidman, J. D. Knight, E. H. Liebert, G. C. Lloyd (Secretary), F. M. Long, B. Longbottom, R. S. McLeod, J. L. Marr, W. B. Marr, J. Marshall, R. B. Matthews, F. O. Mills, Dr. D. K. Morris, J. T. Morris, A. E. Morrison, L. G. E. Morse, F. H. Nalder, F. Nichols, R. B. Perring, Mr. and Mrs. W. G. T. Pope, A. P. Pyne, Calvin W. Rice, G. H. C. Risch, E. Kilburn Scott, P. S. Sheardown, H. B. Simons, W. Summerscales, C. D. Taite, M. J. E. Tilney, R. Tree, J. M. Wallwin, A. C. F. Webb, H. G. Whiting, G. Wilkinson, Capt. and Mrs. R. Ff. Willis, E. B. Woolan.

The English visitors will arrive on board the steamer *Republic* at the White Star Line pier, Charlestown, on Friday, September 2. There will be a reception given to the visitors at Hotel Vendome at 9 o'clock Friday evening. Mr. Charles L. Edgar, chairman of the local reception committee, will preside. His Excellency Governor John L. Bates will extend a welcome to New England.

On Saturday morning automobiles will be in readiness at 8.30 o'clock, to convey the visitors to a number of points of interest, including the new turbine power station of the Edison Electric Illuminating Company, of Boston; the headquarters of the American Telephone & Telegraph Company, and the New England Telephone & Telegraph Company; the park system, around Jamaica Pond, and thence past the Country Club to Soldiers' Field, where a stop of a moment will be made to examine the Stadium. The route will then continue via Harvard Square, Cambridge, where the automobiles will be left and the party will be met by Dr. A. E. Kennelly and other representatives of Harvard University and the following buildings visited: The Museum, Pierce Hall, Jefferson Physical Laboratory, Memorial Hall, Germanic Museum and Harvard Union, where lunch will be served at 1.30 o'clock, preceded by an informal reception by Dr. Henry P. Walcott, representing Harvard College. At 3 o'clock electric cars will be taken, by courtesy of the Boston Elevated Railway Company, and a trip made to the Massachusetts Institute of Technology. The party will then take the train to Fall River, where they will connect with the Fall River boat, landing in New York early Sunday morning.

The New York exercises and functions have already been detailed in full in these columns, and elaborate circulars have been sent out by the New York local reception committee. At 2 p.m. on Sunday a trip will be given by Mr. J. G. White to the guests and members of the Institute up the Hudson and then down the Bay to "Dreamland" for the evening. Next day, Monday, September 5—Labor Day—a visit will be paid to the new Subway. The party will assemble at 9.15 a.m. sharp on the steps of the City Hall, in order to take special train furnished courteously by the Interborough Rapid Transit Company, starting from the City Hall Station at 9.30 a.m. This train will run up the west side subway to the Fifty-ninth Street and Columbus Circle Station, at which the party will disembark to proceed to the new Fifty-ninth Street power house of the Interborough Company. At 11 a.m. the *Nassau,* of the Long Island Railroad Company, will be boarded at the Fifty-eighth Street pier of the Interborough Company, and the party will then proceed up the Hudson River to the Kingsbridge power plant of the New York City Railway Company. The New York Central & Hudson River Railroad Company and the Western Union Telegraph Company have also placed large tugs at the disposal of the committee for transportation purposes, if required. The party will pass by the Ship Canal to the Harlem River, and at 12.30 p.m. will leave the Kingsbridge plant for the Ninety-sixth Street power house of the New York City Railway Company. During this part of the trip a light collation will be served. At 2 p.m. the party will leave Ninety-sixth Street for the Seventy-fourth Street or Manhattan Elevated plant of the Interborough Company, on the East River; and at 3 p.m. will leave that point for the Thirty-eighth Street Station of the New York Edison Company. Guides will be furnished at all the different plants by the companies operating them, and data in regard to each will be found in the New York Electrical Handbook given to each guest from abroad. In the evening a banquet will be given to its guests from abroad by the Institute at the Waldorf at 7, preceded by a reception at 6.30. The attendance promises to be large, as well as distinguished. The price of tickets, with wine, is $9 for members and $6 for ladies. A specially artistic menu and a special souvenir have been prepared.

On Tuesday morning the special circular tour train organized by the Institute will start for Schenectady over the New York Central, reaching the General Electric works at about 12.45 p.m., there to be entertained with luncheon, shown the works and given a trolley trip over the Schenectady Railway to Ballston, where the party will meet its train and proceed to Montreal. The circular tour party will probably be not less than 150 to 160.

Rock Creek, Oregon, Power and Transmission System.

AN interesting power development has recently been completed by the Rock Creek Power & Transmission Company, of Baker City, Ore., in the eastern part of that State. The installation is not particularly notable from any new features of engineering evolved, but for the reason that it shows what can be done by local men with push in building up a power business in the thinly-settled districts of the West and in the utilization of small streams of water.

The plant is located in the Blue Mountains, in Baker County, about 16 miles northwest from Baker City, the water power being derived from Rock Creek, a tributary of the Powder River. The relation of the power house and the transmission lines leading to the sub-station installed in the gold mining districts which surround Baker City, is indicated in the map, Fig. 5.

Rock Creek is a stream which has a minimum flow of 2,500 cu. ft. per minute, and whose maximum flow at extreme high water varies from 8,000 to 20,000 cu. ft. per minute. Water is taken from the creek into the flume by means of a masonry diverting dam, which rests on a rock formation and is 30 ft. long, 3 and 4 ft. thick, and an average of 4 ft. high. Fig. 3 shows the stream at this point and also the intake to the flume.

The flume is 3 ft. by 6 ft. inside and is constructed of 2 x 12-in. Oregon red fir, supported on heavy mud sills. It has 4-in. caps and is covered throughout its entire length, to keep out leaves, pine burs and other debris. The flume is 1¼ miles in length and is built along a mountain ridge on a grade of ⅜ in. to the rod, through close thickets of timber, which serve as a protection against winter weather. Snow falls from 3 to 6 ft. in depth in this section, but no trouble is anticipated from freezing owing to the covering which the snow will give to the flume. At the intake of the flume, leaves and brush are kept out by means of a coarse rack, while the pipeline is protected by a 12-ft. iron rack, set on an incline in the flume, and made of ⅜-in. by 2-in. iron bars, spaced ⅜ in. in the clear. This close spacing is made necessary in order to protect the small nozzle of the exciter water wheel. With this 1¼ miles of flume, 940 ft. effective head at the wheel nozzles is obtained, and 840 cu. ft. of water per minute is used to develop 1,500 hp.

The pipeline connects to the penstock with a taper joint 36 in. in diameter at one end and 24 at the other, and has a suitable standpipe riveted to it. The pressure pipe, which is 2,600 ft. long, consists of 24-in., 22-in., 20-in., 18-in., 16-in. and 14-in. pipe, and is of No. 12 gauge, No. 8 gauge, 3/16-in., ¼-in., 5/16-in. and ⅜-in. steel, respectively.

The pressure pipe, which was furnished by Francis Smith & Co., of San Francisco, is all double-riveted, the 20-in., 22-in. and 24-in. lengths being connected by riveting and the 14-in., 16-in. and 18-in. by chalked joints, with steel collars, leaded.

The pipeline is thoroughly anchored with concrete masonry at all curves, and that the work was well done is shown by the fact that not a drop of leakage showed on the entire line when the water was turned in. The line has six 4-in. air valves, attached along the 24-in., 22-in. and 20-in. pipe sections.

At the power house the main connects through a 14-in. gate valve with a 24-in. receiver (Fig. 4) made of ½-in. steel, double-riveted, and fitted with three 12-in. flanged wheel outlets, two 14-in. flanged pipe outlets and one 3-in. flanged exciter wheel outlet. The wheel nozzles are connected to this receiver by 12-in. seamless flange steel pipe and 12-in. gate valves. The receiver is supported by a solid block of concrete masonry, weighing 100,000 pounds, and is anchored to it by straps and anchor bolts. It has not shown the least signs of creeping or movement of any kind, since the plant was placed in operation.

The power house, which is well illustrated in Fig. 2, is built of

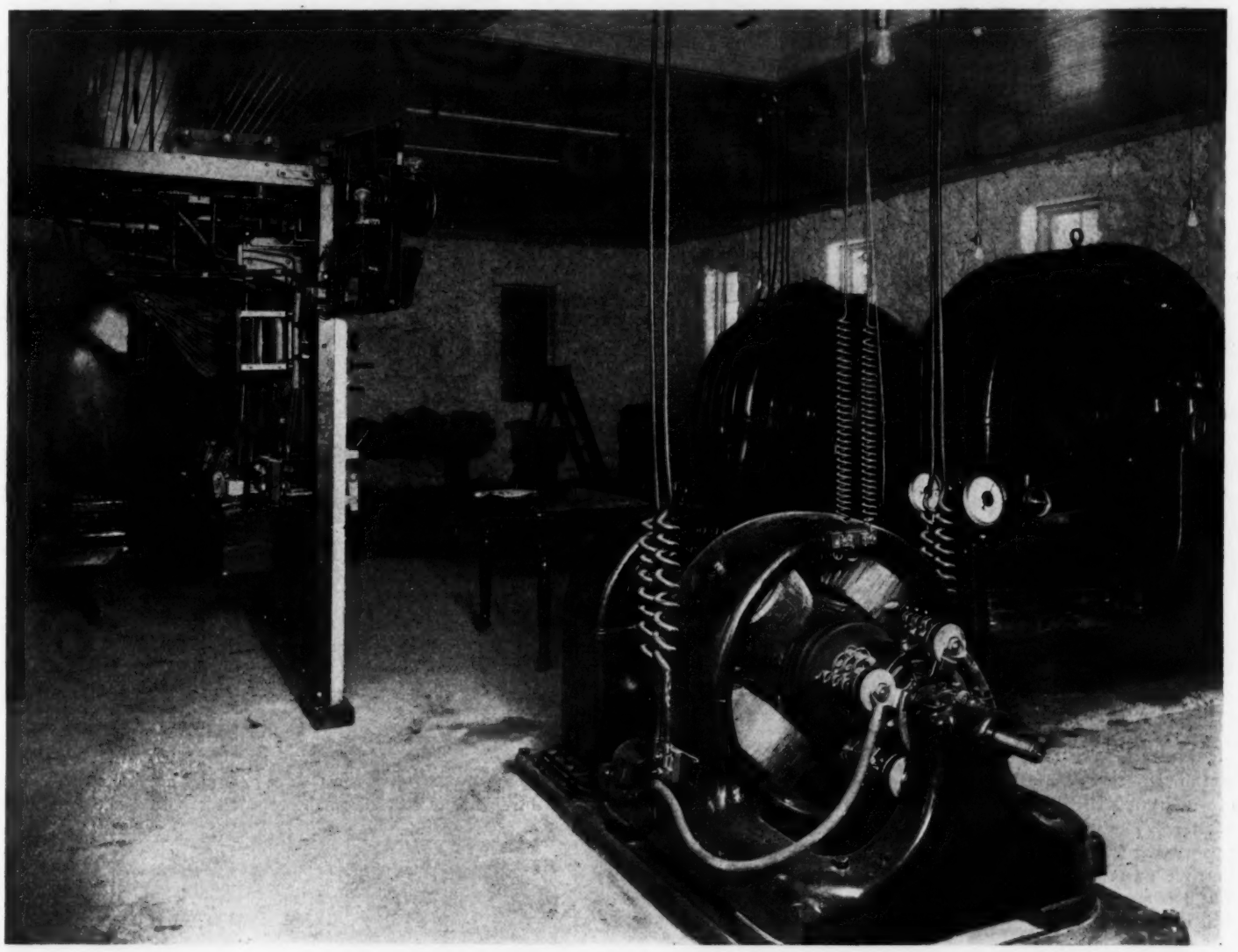


FIG. 1.—VIEW OF INTERIOR OF ROCK CREEK POWER HOUSE.

native stone, with 24-in. walls, and is 34 ft. wide, 64 ft. long and 15 ft. high in the clear. The foundations for the water wheels and generators are of sizes suitable for the machines, 6 ft. deep, and are all tied together by the heavy concrete floor of the building.

FIG. 2.—POWER HOUSE.

The water wheel equipment consists of two 50-in. special wheels, built by the Pelton Water Wheel Company, of San Francisco, and guaranteed to develop 750 hp each, with a 2.45-in. nozzle under 960-ft. head. There is also one 24-in. Pelton wheel for driving the exciter. The two large wheels have deflecting nozzles and for this reason it is not found necessary to have relief valves on the pipeline or receiver. The exciter wheel has a hood nozzle. Each wheel is supplied with a pressure gauge and tachometer. The general outline of the wheel bases and frames is such as to harmonize with the generators.

Water for the operation of the governor, which is of the Lombard type, is taken from the main pipeline on the 300-ft. level and discharged into a large galvanized-iron settling tank, being piped from there through a two-in. pipeline to the power house. This water supply is also used for domestic purposes in the two dwellings built for the operators, in the power house, and for cooling the step-up transformers.

The governor connects directly on to both main wheel nozzles by a suitable shaft connection, and gives very close regulations of speed, considering the fluctuations of load, which mining motors impose on a power system. In order to get close regulation the intentions are to put in a voltage regulator and then, as the exciter wheel has no governor, to attach directly to the exciter an induction motor of the same speed, which will, in the case of a sudden load being thrown on the exciter by the regulator, tend to help out the water wheel and keep the speed up; and in case of a load being suddenly thrown off the exciter, and the speed going up, it will act as a generator, as it will then be working in parallel with the other generators and tend to hold the speed down. This arrangement is expected to give very close voltage regulation.

The exciter water wheel is mounted on the overhang of the shaft of a General Electric 25-kw exciter and its housing and the exciter are mounted on the same base.

The two main wheels are connected through leather link couplings to 400-kw revolving-field, 450-r.p.m., 60-cycle, 2,300-volt, three-phase, General Electric generators, working in parallel. Fig. 1 shows the generating units and also the switching apparatus.

The switchboard equipment consists of an exciter panel, two generator panels and one feeder panel with syncroscope on a swinging bracket. The lightning arresters are of the General Electric multiplex, 2,000-volt, alternating unit type, mounted in banks of twelve on each phase and connected to line through single-pole, high-tension switches, for the purpose of cutting out for cleaning and inspection.

The step-up transformers, three in number, are of 300 kw, 2,300 to 22,500 volts, oil-insulated and water-cooled, connected in delta. The route of the transmission line to Baker City and the surrounding mines is shown in Fig. 5. When completed the line will be about 40 miles in length. It is built of native poles, with 8 and 10-in. tops, the butts treated with carbolineum, set 5 ft. in the ground and spaced 52 to the mile. The line has very few curves, and these few are well guyed. The cross arms are of 4-in. by 6-in. Oregon fir 6 ft. long, bored 5-ft. centers for 1½-in. pins and are bolted to the poles. The third wire is carried on the top of the pole. The pins used are of California eucalyptus, oil-treated and of standard dimensions, as commonly used on transmission lines. The insulators are of the Hemingray Provo, 40,000-volt type. For the main line No. 4 B. & S. gauge bare copper wire is used and for the branch lines

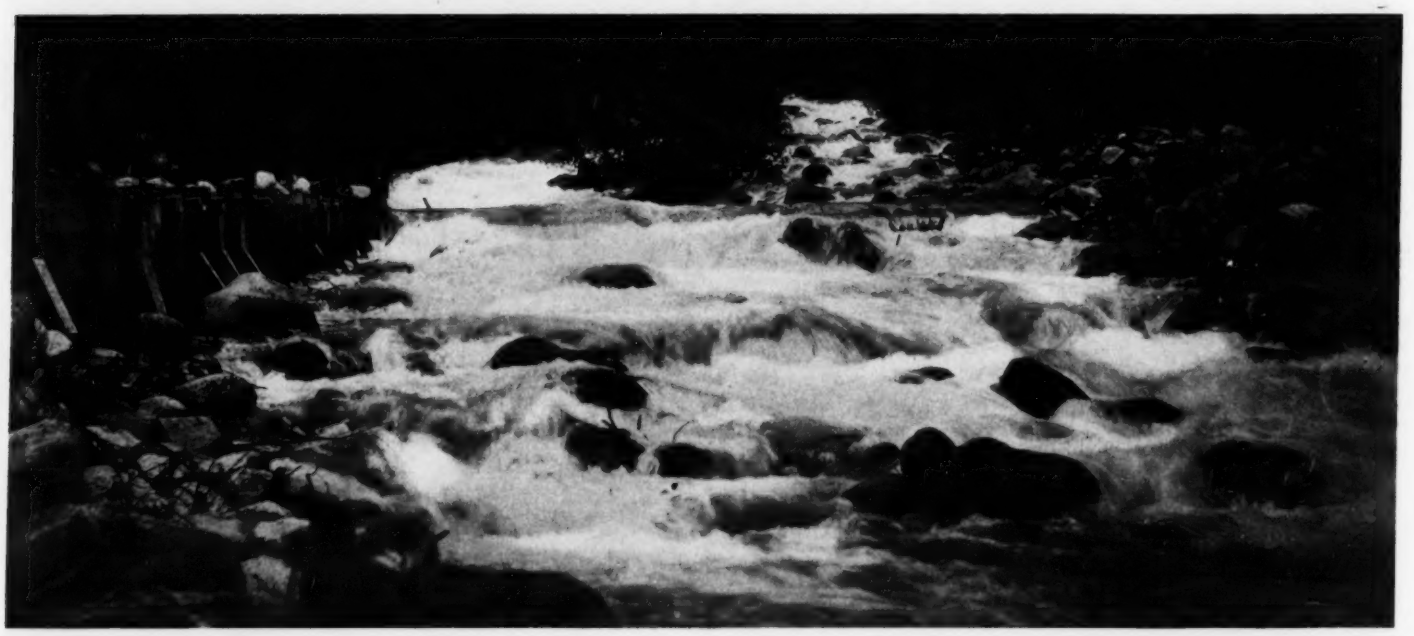


FIG. 3.—DIVERTING DAM AND INTAKE TO FLUME.

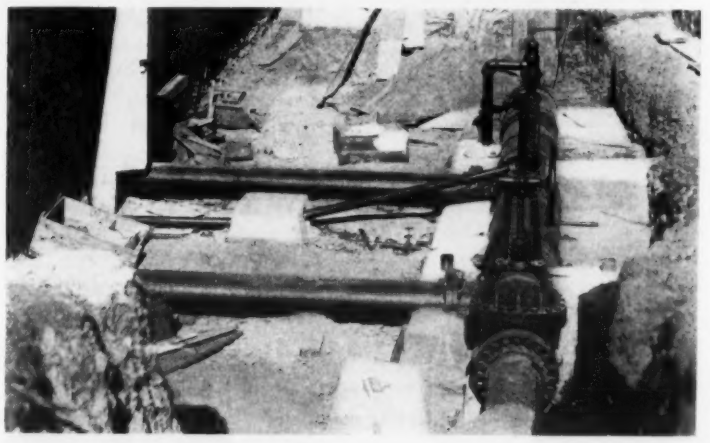


FIG. 4.—RECEIVER AT LOWER END OF PRESSURE MAIN IN REAR OF POWER HOUSE.

No. 6 B. & S. gauge. Ten feet below the cross arms is strung a pair of No. 12 iron wires on brackets, transposed every fourth pole, for a telephone circuit.

There are three sub-stations that take current from this plant, one at Baker City of 40-kw capacity, one at the Cyclone Mine of 200-kw capacity, and one at the United Elkhorn Mines, of 150-kw capacity. A fourth station is being installed at Bourne of 400-kw capacity.

The sub-stations are each equipped with automatic high-tension remote-control switches, placed in firebrick compartments, manual secondary switches, marble switchboard panels and the usual measuring instruments. Each sub-station has also a complete lightning arrester equipment with switches. The power is used at the mines

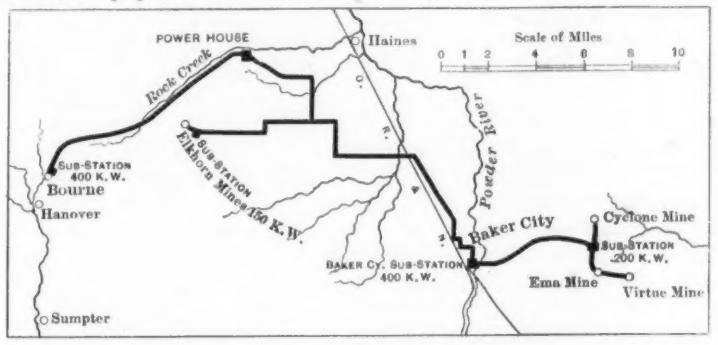


FIG. 5.—MAP OF TRANSMISSION SYSTEM.

in units of from 5 to 100 hp for hoisting, operating mills, compressors, pumps, repair shops and for lighting.

The same stockholders who own the Rock Creek Power & Transmission Company also own, under the name of the Baker Gas & Electric Company, a 400-kw steam plant, equipped with new machinery, and a 50,000-cu.-ft. capacity gas plant, both located in Baker City.

The Rock Creek plant owes its inception to Mr. A. Welch, who recently resigned as manager of the Baker Gas & Electric Company, under whose direction the work was started and pushed. The pipe-

FIG. 6.—TRANSMISSION LINE, LOOKING TOWARD BLUE MOUNTAINS.

line was installed by Mr. J. B. Glatz, of San Francisco, and the general installation and construction were in charge of Mr. F. N. Averill, constructing electrical engineer, of Portland, now permanently located with the company.

The officers of the company are Mr. W. F. Butcher, president; Mr. W. H. Gilbert, vice-president; Mr. W. M. Pollman, secretary and general manager; Mr. J. T. Donnely, treasurer, and Mr. F. N. Averill, assistant manager and electrical engineer. Mr. Averill kindly furnished the data and illustrations for this article.

Storm Warnings By Wireless Telegraph.

On August 26, according to a Washington dispatch, the ocean meteorology bureau was transferred from the Navy Department to the Weather Bureau, under the Agricultural Department. The change is considered to be indicative of a great advance in the general plan of utilizing wireless telegraphy for Government purposes.

Treating Incandescent Lamp Filaments.

BY RALPH MCNEILL.

SO far as the general technical public is concerned, there is much mystery surrounding the details of the manufacture of incandescent electric lamps, though they are made in enormous quantities by several large and numerous small factories in this country. Very little has been written on the subject, except as an outline, and even what there is dates several years back and does not describe present American practice. Details differ under various managements, but the underlying principles of manufacture are now essentially the same. Probably of all the operations to produce a complete lamp, the "treating" or "flashing" of the filament requires the most technical skill of the foreman in charge. An outline of this operation forms the subject of this article. It is not intended to go into the history of the development, but to illustrate present practice merely, with notice of the modifications in use in different factories.

The filament in use to-day for standard lamps of usual candlepower is known as the "squirted" filament of carbonized cellulose. This is made by dissolving cellulose—cotton or filter paper—in a concentrated solution of zinc chloride to a syrupy consistency, and forcing this through a die into wood alcohol, where it congeals as a white thread. This thread is washed to remove the zinc, reeled on drums and dried, after which it is wound on forms and subjected to a very high heat in an air-tight crucible, where it is carbonized.

As received in the treating room the filament is a black thread, sometimes with a very high polish, but more often with a dull lustre and having the familiar loop or coil shape. These are all carefully graded according to diameter, the usual variation allowable being one-eighth of a thousandth of an inch each way. They are generally brittle, but the finer ones can usually be straightened out without damage, and they resume their shape when released. They are bunched and cut to a required length and when separated are ready for the "treating."

This consists in heating the filament to a very high degree of incandescence by an electric current in a very attenuated hydro-carbon vapor, usually gasoline, which is decomposed, carbon being deposited on the filament in a form resembling graphite. The object of this process is, first, to reduce the variable resistance of the raw filament to a standard and even resistance, that required to give the candlepower, voltage and efficiency wanted, and then also to give a surface to the filament which will emit more light for the same consumption of energy than the raw filament. Another and incidental effect, not always recognized, is to complete the carbonization of the filament and to drive off gases which would otherwise be slowly evolved after the lamp was completed, to the detriment of its life.

Filaments carefully graded as to diameter and of the same length will differ very materially as to resistances and in the treating process carbon is deposited upon the surface of the filaments, reducing the resistance and making them all of the same uniform predetermined resistance. The diameter and length of the raw filament is usually so selected that the cold resistance of the treated filament is about half, or a little less than half, of the raw filament, though there is much latitude in this respect permissible. A filament treated down to half resistance is said to have a 50 per cent. treatment, and to other amounts accordingly. The treated filament for a 16-cp, 110-volt, 49.6-watt lamp (3.1 watts per candle), should measure cold about 510 ohms and be from a raw filament measuring between 1,100 and 1,200 ohms. If the required size of stock is not at hand other sizes may be substituted, but life tests of lamps show that it is not desirable to use less than 45 per cent. of treatment, and if more than 65 per cent. is used the difficulties of treating become greater—hence cost more—without producing any corresponding gain in the finished lamp.

Raw filaments are often "spotted"; that is, if lighted up by an electric current in a vacuum, some parts will be brighter than others. This is due to a variation of resistance in the length of the filament, those parts having the higher resistance becoming brighter than the others, since the current passing develops there more heat. This higher resistance is usually due to a smaller cross-section at that point, though sometimes there appears to be an increased specific resistance. Spots may be a gradual brightening for an inch or more or only a tiny point. They invariably indicate a weak portion of the filament, and it was originally one of the chief objects of treating to eliminate them. The spot being hotter than the other part of the

filament decomposes the hydro-carbon vapor more quickly, and the carbon depositing there more rapidly than at other parts builds up the filament to a uniform resistance throughout its length. Experience shows, however, that a spotted raw filament produces a lamp that burns out sooner than a lamp made from a perfect filament, though the burn-out occurs at a different point. The reason for this will be discussed later.

Practically all of the energy of the current passing through the filament is dissipated as radiant heat and light, and it is desirable that the proportion of light to heat emitted be as large as possible, for economy. A raw filament, or one with a dull finish, will radiate less light per watt consumed than a properly treated filament having

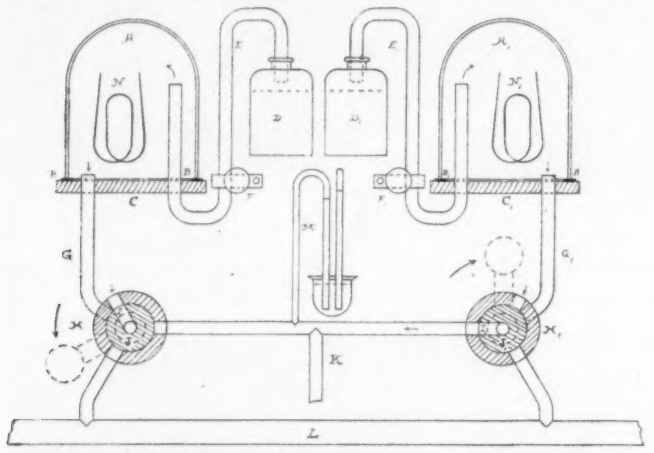


FIG. 1.—TREATING TABLE—MECHANICAL ARRANGEMENT.

a highly polished steel appearance, and it is part of the treating process to produce such a finish.

The third effect of treating is more completely to carbonize the filament as stated. When treating, the filament is raised to a much higher temperature than was possible while in the crucible when originally carbonized, and besides, when the hydro-carbon is decomposed and the hydrogen set free, the latter helps to eliminate the last traces of the oxygen originally present in the cellulose. Traces of undecomposed cellulose can be detected in most filaments before treatment, but rarely afterward.

The apparatus used to treat filaments differs greatly in the various factories, but Figs. 1 and 2 illustrate, in diagrammatic form, and without details, a type of treating table largely used until recently in most factories and still in use in the smaller ones. The working principle is the same in all, the improvements made having been chiefly in the line of more rapid manipulation.

A, A_1, Fig. 1, are two heavy glass shades of bell shape with accurately ground edges resting on the rubber gaskets, B, B, B_1, B_1, and making air-tight joints with the brass plates, C, C_1. At D, D_1 are two heavy glass bottles containing gasoline (Rigoline) of the lightest quality, and connected by brass or glass tubes, E, E, with the shades as shown. F, F_1 are two pinch-cocks to adjustably compress short pieces of rubber tubing inserted in the tubes, E, E_1, the tubing being interrupted there for the purpose. These pinch-cocks regulate the supply of gasoline vapor to the shades. At H, H_1 are three-way plug-cocks with plugs J, J_1, each being connected to a shade by tubes G, G_1. As shown by dotted lines, G, G_1 enter at a different level from that of the other openings in the shell of the cocks and by an annular groove in the plug and a central hole communicate with the ports, I, I_1. At K is shown a tube leading to a very high vacuum air pump, and with a manometer at M, to indicate the degree of vacuum and also a barometer tube for comparison. L is a tube leading to an air pump of large capacity and may be attached to a number of tables, and is employed to remove the bulk of the air and relieve the high vacuum pump. The high vacuum pump is connected to only one treating table. At N, N_1 are shown the filaments to be treated, but without the clamps holding them and their electrical connections.

The operation of the table is as follows: In the position of the cock, H, the port, I, is open to the air, and in consequence the shade, A, may be freely removed and an untreated filament inserted in the clamps, as at N. By means of a handle attached to the plug, J, and shown by dotted lines, the plug is revolved—with the arrow—until the port, I, communicates with L, which promptly removes the bulk of the air. A further revolving of J brings I to connect with K, completing the vacuum. Cock H_1 should previously have been turned so that the port, I_1, did not communicate with K, and the manometer mercury should then rise until about 1/16 inch below the barometer level, otherwise there is a leak or the pump is not in perfect condition. The pinch-cock, F, may now be released slightly, permitting gasoline vapor to enter the shade, and after circulating around the filament go to the pump. This will depress the level of the mercury in the manometer, and F should be so regulated that the manometer drops ½ to ¾ in. Current is then permitted to flow through the filament until treated and then automatically cut off, as will be explained below.

While N is being treated the operation just described for shade A is being repeated for shade A_1, up to the point where the high vacuum pump is put on, and when N has been cut out the plug-cocks are turned to the positions shown, and after regulating F_1 as F had previously been done, current may be admitted to N_1 and a new raw filament put in place of N. A thick oil or a grease is used to smear the gaskets and the plugs of the cocks to make them air-tight, and in the case of the cocks, for lubrication also.

Reference to Fig. 2 will show the electrical connections involved. While direct current may be and has been largely used for treating, alternating current has several distinct advantages, and its use will be described here. At a (Fig. 2) is a transformer with a single coil, supplied with single-phase, alternating current at (say) 220 volts. The single coil has numerous leads of higher voltage, as shown, and with a potential difference between adjacent leads of 20 volts, except the first, which is 220 volts. These leads go to successive buttons of an arm selector, d. At b is a double-pole switch for cutting off the main circuit of the treating table from the transformer. It is evident that b could have been put in the main leads to the transformer, but it is often desirable that one transformer supply several tables, hence it is located as shown. At c is a single-pole, double-throw switch, enabling one pole of b to be connected to either the first or last button of d, the other pole of b remaining connected to the arm of d.

Between the first and second buttons (going clockwise) it will be

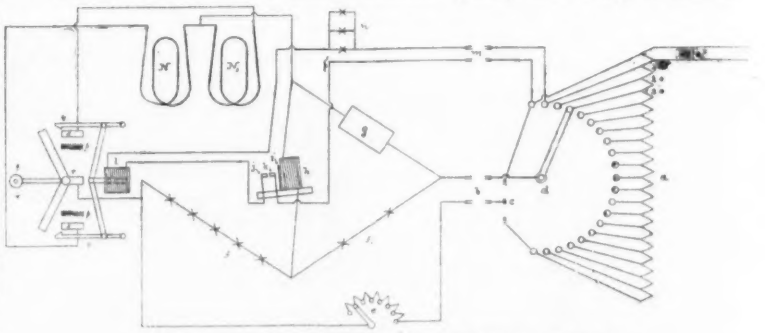


FIG. 2.—TREATING TABLE—ELECTRICAL CIRCUITS.

seen that there is a potential difference of 220 volts, and between the second and third 20 volts, while between the first and third there is 240 volts, and so on. As shown, then, with c thrown to connect b with the first button of d, by moving the arm of d, voltages between 220 and 600 may be obtained by steps of 20 volts. If c is thrown to connect b with the last button of d, then, beginning with a difference of 20 volts and moving the arm counter-clockwise, voltages by 20-volt steps may be obtained up to 380 volts, and then to the last button, 600 volts. Thus any voltage may be selected for treating, within 20 volts and between 20 and 600 volts. In series with the table circuits is a rheostat, e, so proportioned as to make the finer adjustment of voltage when required. A lamp bank is sometimes substituted for e, but is not capable of as accurate adjustment as the rheostat.

A glance at Fig. 2 shows that the filament being treated is in one side of a Wheatstone bridge with a proportion formed of incandescent lamps, f, f_1, a variable resistance, g, and a galvanometer, h. In place of f, f_1 an ohmic resistance or a reactance may be used, but lamps are very satisfactory and consume but little energy. The plug resistance, g, is satisfactory if having a total of 111 ohms, varying by .1 ohm. The galvanometer, h, is merely a coil of fine copper wire of about 80 ohms resistance, having an iron wire core. The armature, i, is a strip of sheet iron ordinarily held against the coil by the latter and pivoted at the bottom, but when the filament is treated and the current in h approaches zero, the slight tilt of the coil permits i to be released and strike a small carbon point, k, mounted on a light spring and forcing k against a similar carbon point, j, completing a local circuit, as shown, through the double-pole switch, m, lamps,

n, and solenoid, *l*, the latter actuating the cut-out, *o*. As soon as the cut-out acts and the filament is disconnected the current through *h* becomes appreciable again and attracts *i*, permitting *j* and *k* to separate and break the local circuit.

The cut-out may take many forms, but is essentially a circuit-breaker, the trigger of which is not operated by its own current, but that of the local circuit. As shown, it is a single-pole, double-throw rocker switch, with springs, *p*, *p*, to tend to keep it open, and latches, *q*, *q*, to lock it in either closed position. These latches are opened by the solenoid, *l*, when the latter is energized, and the rocker released, breaking the circuit, in a manner that needs no description. The hinge, *r*, of the cut-out is connected to the rheostat and the resistance, while the two clips, *s*, *s*, are connected, one each to the terminals for holding the treating filament, one under each shade. The other two terminals, one under each shade, are connected together and to the galvanometer and plug resistance, as shown in the diagram.

When the filament is under the bell, the vacuum and gasoline being properly adjusted, the operator throws the handle of the cut-out to the right or left, according to the filament to be treated, completing the circuit through the blades, *s*, and at the same time latching the cut-out shut. As the filament is being treated its resistance decreases and the two points on the "bridge" between which the galvanometer, *h*, is connected become nearly of the same potential and the magnetism of the coil, *h*, becomes too small to hold the armature and it falls, actuating the cut-out. Variation of the plug resistance, *g*, will change the resistance of the treating filament when *h* operates. It is by manipulation of *g* and occasionally by shifting the proportions, *f* and f_1, that the resistance of the treated filament is regulated. The proper operating voltage for the lamp is determined by the resistance of the raw filament.

Compulsory Working of Patented Inventions.—A British View.

BY W. CRAIG HENDERSON, D.SC., *Barrister-at-Law.*

THE question whether patentees ought to be compelled, on penalty of forfeiture, to "work" their inventions in the country where a patent has been obtained, is one of considerable importance, and its interest for practical men has been shown by the recent communications in the columns of ELECTRICAL WORLD AND ENGINEER. It is evident that opinion in America is much divided on the subject, and as the same question has been frequently discussed of late in Great Britain, it may not be out of place to give here an indication of the lines upon which the question has been treated in England along with an expression of the opinion to which the writer has been led by a study of the operation of the British patent laws. The principles regulating the grant of letters patent in America differ in many respects from those in force in Great Britain, but the laws of the two countries are, so far, at one on the question of compulsory working, and, therefore, general arguments on this point which are applicable to the one country may probably also apply to the other.

Let it be said at once that the view expressed in what follows is adverse to compulsory working. In England, as in America, opinion is much divided on the subject, but it is important to note that the English advocates of compulsory working, who belong mostly to the manufacturing class, base their case almost entirely on the ground of unfair foreign competition. Their complaint is that great injury is done to their trade by foreign manufacturers, who take out patents for inventions in their own country and also in Great Britain, afterward working the invention only in the foreign country and sending the manufactured goods free of duty into the British market, where they compete with the products of home manufacturers, who cannot use the invention. Now, admitting that there may be a real grievance here, we must point out two things. In the first place, in the statement of the manufacturers' case, there is a confusion of two issues which ought to be kept distinct, viz., the operation of the patent laws, and the effect of the British fiscal policy. We cannot tell how much of the grievance lies in the absence of compulsory working and how much is due to the importation of goods *free of duty*. Of course, if British manufacturers suffer from this importation and are prevented from retaliating by the high tariffs imposed upon their goods on admission to foreign countries, it may be necessary to seek a remedy; but it is impossible to make the patent laws a set-off against any ill effects resulting from free trade.

In the second place, even if we overlook the confusion of issues, we must ask, Would compulsory working help matters? Even if the foreign firm were compelled to work its patented invention in Great Britain, home manufacturers would still be unable to compete. The result would probably be that merely sufficient working to satisfy the letter of the law would be done in England, while the real working would be done abroad, as at present, and the products exported to the British market. Is this importation of patented goods, manufactured by the owners of the patent, to be forbidden? To do so would involve a complete change in British legislation quite apart from the patent laws. The strongest argument available to the manufacturers would be that the grant of a patent is for a "new manufacture" introduced into the country, and that in such a case as that described above, no such "new manufacture" is introduced. But that is not an argument for compulsory working; the real remedy is different, and we shall see presently how the British patent statutes deal with the matter.

The object of explaining here the nature of the case put forward in England for compulsory working is to show that it is largely based upon grounds which are not applicable to America, and that for that reason resolutions of British Chambers of Commerce recommending the introduction of compulsory working must not be cited in America in support of the American case. So far as the writer knows, no serious attempt has yet been made in England to advocate compulsory working apart from the question of foreign competition.

Let us now look more closely at the general question in issue. An academic discussion on theoretical grounds will not help us much, as so much there depends upon the view taken of the primary object of the grant of letters patent. Some say it is the reward of the inventor and the encouragement of the inventive faculty, while others maintain that the chief consideration must be the interest of the community at large. The ideal system would be one in which these two objects were perfectly balanced; but we cannot hope for an ideal system and it will, therefore, be more useful to discuss the question, with which we are now dealing, as one of practical policy. In the first place, then, can we learn anything of the consequences of compulsory working in countries where that practice is adopted? It is not easy to obtain comprehensive information on this subject, but now and again individual opinions may be obtained from those who have had experience of the system. One such opinion may here be given. It is taken from the Blue Book containing the evidence given before a committee appointed by minutes of the Board of Trade in 1900 to inquire into the working of the British Patent Acts. The following extract will be found in the examination of Dr. Weinberg:

"2749.—[Chairman.]—I think you have formed some opinion as to the result on French manufacturers of that compulsory working by German manufacturers in France?—Yes.

2750.—Will you kindly tell us what it is?—The consequence of that law was that I think it was five German manufacturers established branch works in France; previously there had been about half a dozen French firms at Lyons, Paris and other places, and after the introduction of the German industry into France they could not compete.

2751.—[Mr. Fletcher Moulton.]—They were all killed out?—Yes, with the exception of one in Paris, which was one of the first firms in the world before, but which is now a very small concern.

2752.—[Chairman.]—Your conclusion is that, instead of benefiting the French people by the compulsory working of the Germans in France, the result has been to injure the French people?—Yes.

2753.—I suppose the workmen employed are, for the most part, Frenchmen?—The foremen and chemists were Germans, but the workmen were all French people. There were several hundred Frenchmen employed.

2754.—And the profits go away to Germany across the Rhine?—Yes, they are all limited companies, and the shares, with few exceptions, are held by Germans."

It appears, then, from this evidence that compulsory working, when effectively carried out, may, in the case of foreign patentees, only result in the death of some of the home manufactories, even where these are run by old and well-established firms, while the profits earned by the new firms, which have displaced them, all go out of the country. Such an instance as that given by Dr. Weinberg is, of course, not conclusive in the matter, but it shows that compulsory working may have a very different effect in practice from that anticipated by manufacturers who advocate its introduction.

The great difficulty, however, with regard to compulsory working is in determining what amount of working will be considered adequate for the fulfilment of the law. In some countries where this system is in vogue, this working is in many cases the merest make-believe, especially in the case of mechanical inventions, and it is possible to obtain protection for an "invention" which will never be used practically, and which could not "work" in a commercial sense. If the public is really ready for the invention, working will take place without compulsion, but compulsory working will not stop "paper patents." And if it be to stop the evil of "paper patents" that compulsory working is to be introduced, then looking at the matter in the light of British practice, for which alone the writer is qualified to speak, it seems to him that the result would be rather to strengthen than to weaken the position of the owners of such patents. A "paper patent" is one which will never be of practical commercial value, but which may, nevertheless, block subsequent inventors who have useful inventions on the same lines. In litigation in Great Britain these patents are often set up as anticipations of the patent sued on, but they rarely succeed in their purpose, as the British courts give tremendous weight to *utility*, and if it be shown that the plaintiff is in possession of a patent for an invention which has proved useful in practice on a commercial scale, while the alleged anticipations, though bearing some resemblance to it, have never been more than paper specifications, the judges will uphold its validity. The House of Lords has gone very far indeed—some say too far—in attaching the greatest importance to utility in its interpretation of patent specifications. In this state of affairs, then, it would seem that compulsory working would strengthen rather than weaken the position of defendants in such actions, as they would then be supplied with the argument, "These anticipations, which we put forward, have all been 'worked' in the country and have fully satisfied the law in that respect. They may have been before their time and have, therefore, not been used so extensively as the patent now in issue; but in the light of our present knowledge they might now be turned to commercial use, and you cannot rob an inventor of his reward merely because he is before his time. In any event, you cannot say they have not been worked." It may be said that an assumption is here made that it will be possible to satisfy the law as to working even for paper patents. Frankly, that is so. It does not seem to the writer to be practicable to devise a scheme as to working, at once reasonable and just, which will stop blocking patents, and yet allow the grant in every case where an element of usefulness appears.

In the United States the evil of paper patents will appear at an earlier stage than in Great Britain. The Patent Office there makes a search for anticipations before granting a patent; as the result of that search some of these paper patents may be put in interference, and at that stage it may be too early for the applicant to show the great utility of his invention, and perhaps the officials might not in any case give the same weight to it as English judges do. That is one reason why people in England prefer their system, without a search, to the American system; they dislike giving too much power to permanent departmental officials and prefer to put their trust in the judges. That, however, is a matter outside the present discussion. The real point is that the arguments stated above would apply also in the case of interferences in the United States Patent Office.

Is there, then, any remedy? We believe there is, and that it is to be found in the system of compulsory licenses. That would effectually meet the case where foreign patentees work their inventions only in their own country. This view is in accordance with that expressed by the British committee, to which reference has already been made. Its conclusion was expressed in the report in these words:

"A suggestion has been made that some plan for the defeazance of a patent in the event of its not being worked in this country would be preferable to the compulsory granting of licenses. We are not able to accede to this suggestion."

In consequence of the recommendations of this committee various amendments were made in the law by the Act of 1902, of which Section 3 deals with this question of compulsory licenses. As the terms of that section may be of interest in America, where no similar provisions seem to exist, the important parts are here set out:

"3. Section 22 of the principal act (relating to the grant of compulsory licenses by the Board of Trade) is hereby repealed, and the following provisions shall be substituted therefor:

(1) Any person interested may present a petition to the Board of Trade alleging that the reasonable requirements of the public with respect to a patented invention have not been satisfied, and praying for the grant of a compulsory license, or in the alternative for the revocation of the patent;

(2) The Board of Trade shall consider the petition, and if the parties do not come to an arrangement between themselves the Board of Trade, if satisfied that a *prima facie* case is made out, shall refer the petition to the Judicial Committee of the Privy Council, and, if the board are not satisfied, they may dismiss the petition;

(3) Where any such petition is referred by the Board of Trade to the Judicial Committee, and it is proved to the satisfaction of the Judicial Committee that the reasonable requirements of the public with reference to the patented invention have not been satisfied, the patentee may be ordered by an order in council to grant licenses on such terms as the said committee may think just, or, if the Judicial Committee are of opinion that the reasonable requirements of the public will not be satisfied by the grant of licenses, the patent may be revoked by order in council; provided that no order of revocation shall be made before the expiration of three years from the date of the patent, or if the patentee gives satisfactory reasons for his default;

(4) On the hearing of any petition under this section the patentee and any person claiming an interest in the patent as exclusive licensee or otherwise, shall be made parties to the proceeding, and the law officer (i. e., the Attorney-General or Solicitor-General), or such other counsel as he may appoint, shall be entitled to appear and be heard;

(5) If it is proved to the satisfaction of the Judicial Committee that the patent is worked, or that the patented article is manufactured exclusively or mainly outside the United Kingdom, then, unless the patentee can show that the reasonable requirements of the public have been satisfied, the petitioner shall be entitled either to an order for a compulsory license or, subject to the above proviso, to an order for the revocation of the patent;

(6) For the purposes of this section the reasonable requirements of the public shall not be deemed to have been satisfied if, by reason of the default of the patentee to work his patent or to manufacture the patented article in the United Kingdom to an adequate extent, or to grant licenses on reasonable terms: (*a*) any existing industry or the establishment of any new industry is unfairly prejudiced, or (*b*) the demand for the patented article is not reasonably met."

The remaining sub-sections deal with points of practice.

These provisions seem to provide a fair remedy for any evils that may arise under the present system. They make it possible to insure that a really useful patent shall be worked in the country, but compulsion will only be brought into play at the instance of an aggrieved party, so that patentees will be left alone unless they begin to make themselves objectionable. The provision for defeazance in certain cases, instead of granting compulsory licenses, is merely a more explicit enactment of the old provision of the Statute of Monopolies that a grant of letters patent shall not be made if it be to the "hurt of trade or generally inconvenient." The decision on the question whether licenses shall be granted or not, is left, it will be observed, to a judicial body, which is well qualified to deal with the matter, and that body also fixes the rates to be paid for a license. If a patent were merely a blocking patent, of no use in itself but sufficient "on paper" to prevent the use of a subsequent practical invention, it is quite certain that the Judicial Committee of the Privy Council would know how to deal with it and would soon put an end to obstruction.

The opinions given above are put forward with diffidence as the writer recognizes that, however valid they may be in England, they may be lacking in force in the United States, owing to altered circumstances and differences in the patent laws. Of this, however, others must judge, and in any event it may be of interest to American citizens to know how the difficulty which they are anxious to solve is dealt with in the sister country.

Convention of Municipal Electricians.

The ninth annual convention of the International Association of Municipal Electricians will be held at St. Louis, September 13 and 14. The official headquarters will be at the Grand View Fraternal Hotel, which is conveniently situated with reference to the Exposition grounds. This is one of the co-operating bodies of the International Congress. Messrs. W. H. Bradt, Frank C. Mason and Walter M. Petty will represent the Association at the Congress.

Calculation of Alternator Regulation.

BY C. E. CANFIELD.

PAPERS of great interest have recently been published on the subject of alternator regulation,[1] and it is designed in this article not to bring out any new points in theory, but simply to set forth a method of calculation which has been in use in the actual designing and testing of machines for several years. The method takes account of the several most important factors which affect regulation and has given results eminently satisfactory as compared with either of the two usual methods, one of which assumes the synchronous reactance to be all self-inductance, and the other considers it to be due wholly to armature reaction or back ampere-turns.

The self-inductance method gives fairly good results at unity power factor, but at lower power factors the results obtained are far too high. The armature reaction method is about equally good at unity, but at lower power factors it, in turn, gives results far too low. Some method must be used, therefore, that takes account of the two effects independently. In the paper by Behrend the errors of the above methods, especially on zero power factor loads, are excellently shown by his "pessimistic" and "optimistic" curves, respectively.

In 1901 Mr. Edward Heitmann devised independently the method herein described. Others have worked along similar lines and arrive at similar methods of calculation, especially H. M. Hobart and Prof. Adams. It is in fact the only logical way to calculate the regulation of an alternator, on the basis of the actual events which occur within the machine. Its only objection as a testing method is that it is not as simple as could be desired, but to measure complex results more or less complex means must be employed. Short cuts may answer the purpose for a line of machines in which the ratio of self-induction to armature reaction remains about the same, but as soon as these quantities begin to vary relatively trouble is encountered.

The regulation of an alternator is defined as the rise in terminal voltage, which occurs when a full load is thrown off and the excitation kept normal, and the percentage regulation as the ratio of this increment to the initial e.m.f. It is obvious, then, that if the machine gives normal voltage on open circuit, when a load is thrown on the excitation must be increased by an amount sufficient to overcome the various internal reactions.

These internal reactions are usually separated into three classes. Resistance drop, or the e.m.f. due to the straight ohmic resistance of the armature circuit; self-inductance drop, or that due to the local fields set up by the current in the armature coils, and armature reaction, or the resultant demagnetizing effect of the ampere-turns of the several phases.

In designing it is necessary to calculate the values of these several quantities from the dimensions of the machine, and to combine them in their proper phase relation so as to obtain the necessary field ampere-turns to overcome their combined effects. Then, having a previously-calculated saturation curve, from this may be ascertained the rise in voltage which these ampere-turns will produce on open circuit.

In the testing room a saturation curve is first obtained, and then these separate quantities are measured. It being impossible to load any but the smallest alternators, so as to obtain the regulation under conditions of normal load, it is necessary to measure separately the factors which enter into the problem, and to calculate their combined effect.

From the design of the machine these quantities can be calculated as follows:

Resistance drop.—This is, of course, calculated from the length of conductor per phase or leg, its cross-section and the current flowing. A convenient formula for resistance at 60° C. is:

$$R = \frac{12\ t\ l}{c.m.}, \qquad (1)$$

where the constant, 12, is the resistance per mil-foot, t the total turns per phase, l the length per turn in feet, and $c.m.$ the cross-section of conductor in circular mils. The resistance drop is increased somewhat by heating due to eddy currents in the conductor, but with properly-selected conductor this increase is negligible in regulation calculations, as the $I\,R$ drop is at most but a small factor in the total drop. The use of stranded cable for large conductors eliminates eddy currents almost entirely. Laminated conductors also give excellent results when so placed in the slot as not to be cut by more leakage lines on one edge than on the other.

Self-inductance drop.—The armature self-inductance drop per phase, with fields removed, is caused by two sets of leakage lines, those which thread around the coil within the armature iron and pass across the slot opening from tooth to tooth, and those which encircle the coil in air on the free ends.

Considering first the embedded portion of the coil within the iron, the coefficient of self-induction, L, per pole, is proportional to the

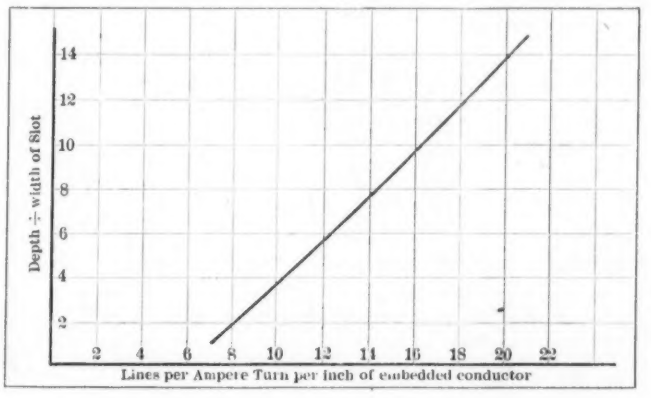


FIG. 1.—CURVE FOR CONCENTRATED WINDING.

c.g.s. lines per ampere-inch which encircle the conductors, the length of embedded portion or leg and the square of the number of conductors per pole. The lines per ampere-inch are the only quantities here not directly obtainable. Hobart[2] has described a method of calculating this leakage for commutating coils. Tests for the purpose of determining this leakage were made by Heitmann on stationary armatures of alternators, the results being shown in the curves of Figs. 1 and 2. Curve 1 shows the variation of this leakage with the ratio of depth to width of slot, and is plotted with the ratios of slot dimensions as ordinates and lines per ampere-inch as abscissæ. This assumes all the conductors grouped in one slot. For distributed windings we go to curve 2 for a correction factor to apply to the quantity obtained from curve 1. Curve 2 is plotted with slots per pole per phase as abscissæ and the correction factor as ordinates.

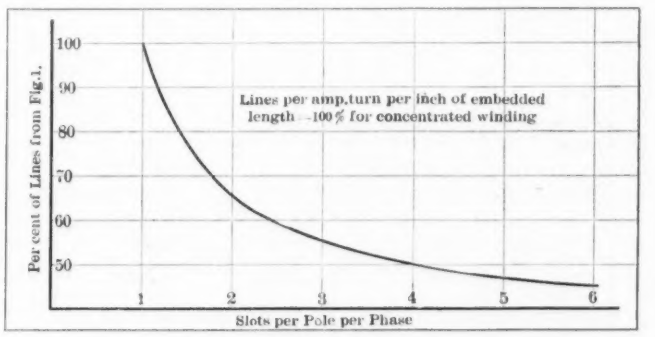


FIG. 2.—CURVE FOR DISTRIBUTED WINDING.

From these curves, then, is obtained the only remaining factor necessary to determine L for the embedded length.

For the free ends of the coils a leakage flux of two lines per ampere-inch is assumed. This value has been obtained experimentally by Hobart and others and is approximately correct. The number of conductors per pole to be used in this calculation depends on the form of winding. As only two forms are used to any extent in alternators, only these will be considered here. These forms are the 2-coil per slot, or double-layer winding, and the 1-coil per slot, or single-layer winding. For 2 coils per slot, the more common form for moderate voltages, the position of the free ends is such as to make the self-inductance just half as large as in the 1-coil per slot winding. This latter is preferred for higher voltages from 5,000 up. The value of L, then, is dependent upon the lines per ampere-inch encircling the conductors, the reciprocal of the number of coils per

[1] Adams, *Harvard Engineering Journal*, 1902. Behrend, A. I. E. E., *Proc.*, May 19, 1903. Hobart and Punga, A. I. E. E., *Proc.*, April 22, 1904.

[2] Commutating Machinery, *Journal* Institute Elec. Eng., London, Dec., 1901.

slot, the square of the number of conductors per pole, and the free length per turn, as expressed in the following equation:

Let P = number of poles,
Z_1 = lines per amp.-inch from curves 1 and 2,
Z_2 = " " " in air = 2,
C_p = conductors per pole = 2 (turns per pole per phase),
l_1 = length of iron in armature (without ventilating ducts),
l_2 = free length per turn = (mean length − $2l_1$),
n = number of coils per slot.

Then for the embedded length:

$$L_e = \frac{P}{10^7} Z_1 C_p^2 l_1$$

For the free ends:

2 coils per slot:

$$L_f = \frac{P}{10^8} Z_2 \left(\frac{C_p}{n}\right)^2 l_2 = \frac{P}{10^8} .5\ C_p^2\ l_2.$$

1 coil per slot:

$$L_f = \frac{1}{2}\frac{P}{10^8} Z_2 \left(\frac{C_p}{n}\right)^2 l_2 = \frac{P}{10^8} C_p^2\ l_2.$$

For either 1 or 2 coils per slot this can be written:

$$L_f = \frac{P}{10^8}\frac{C_p^2\ l_2}{n}.$$

Then for the entire circuit:

$$L = L_e + L_f = \frac{P\ C_p^2}{10^8}\left(Z_1 l_1 + \frac{l_2}{n}\right).$$

From this the inductive drop or $\omega L I$ is at once obtained, where $\omega = (2\pi \times frequency)$ and I = current in amperes.

As this formula gives the e.m.f. for the armature alone in space, it may be well to consider the variation in self-inductance due to the proximity of the poles and magnetic circuit of the field. As the leakage of lines across the tips of the teeth is increased somewhat when the pole is directly under the leg of a coil, the e.m.f. will be slightly larger at this point. On the other hand, a still greater increase of flux takes place, with corresponding increase of self-inductance, when the pole is under the center of a coil. In Fig. 3 is

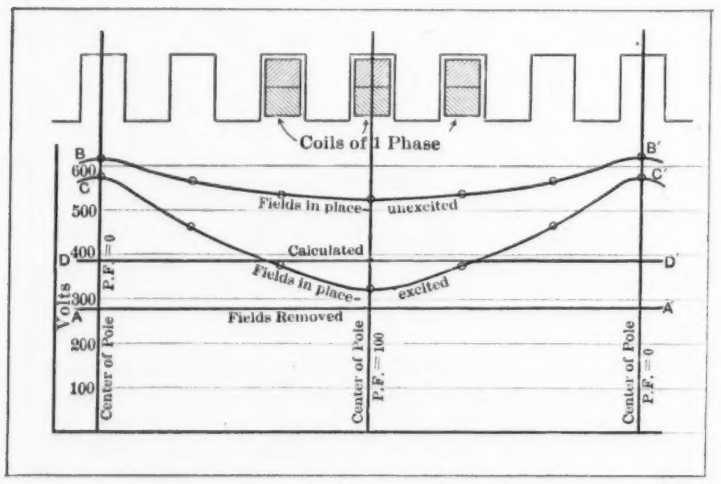


FIG. 3.—CURVES OF ARMATURE IMPEDANCE.

plotted a set of readings taken on a 250-kw, 2,400-volt, 60-cycle, two-phase alternator designed to run at 300 r.p.m. This machine has six slots per pole, .75 in. by 2.25 in. and ¼-in. air-gap. The pole face, instead of being parallel to the armature surface is curved so as to produce a sine wave of flux, by increasing the air-gap each way from the center proportional to $\frac{1}{\cos\theta}$. The three coils of the phase being tested are shown in the slots. Ordinates of the curves represent e.m.f. of self-induction, and abscissæ the fixed positions of the pole at which the readings were taken.

The line $A A'$ is the e.m.f. of self-induction or impressed e.m.f. with normal armature current and frequency and fields removed. This is, of course, a straight line. $B B'$ represents the impressed e.m.f. with fields in place but unexcited. The effect of saturation at normal field current is shown by the curve $C C'$. This is the curve with which we are most concerned. When the pole is under the leg of the coil, the self-inductive e.m.f. is a minimum, but still slightly greater than the free e.m.f., $A A'$. This is due, as mentioned above, to the increased tooth leakage through the pole tip. This position of the pole corresponds approximately to the running conditions at unity power factor. Again, when the pole is under the center of the coils, the e.m.f. rises to a peak at its maximum value. Saturation is seen to have less effect on this peak than on the lower portion of the curve. This peak is due to the three coils acting collectively on the air-gap to produce a greater flux around through the field yoke than at the minimum point of the curve, where each coil is practically producing its own local field. Then, too, all the lines forced across the air-gap here, at the peak position, are threading all the coils. This latter pole position corresponds approximately to zero power factor.

The curve $C C'$ does not represent the running conditions, however, as all the readings were taken with normal or unity power factor excitation and stationary fields. Had the zero power factor excitation been used at the peak position, the e.m.f. would have been somewhat reduced, due to increased saturation. Then again, the peak of the curve represents, with the fields stationary, a pulsating flux through the poles and yoke due to the alternating ampere-turns of the armature. But when the machine is running these ampere-turns become simply back ampere-turns, at zero power factor. These are counteracted by increased field excitation, which is of the same frequency, relative to the armature. So that while the armature current may, as armature reaction, reduce the pole flux, it cannot produce fluctuations in it. Therefore, the cause of this apparent rise in self-induction at zero power factor, as measured with poles stationary, becomes, under running conditions, simply armature reaction. The real self-induction would fall from the value, as represented on the curve $C C'$ at unity power factor, to the value $A A'$ at zero power factor.

The value of the self-inductive e.m.f. as calculated by the formula previously given is represented by the straight line, $D D'$. In a number of tests of this kind the calculated value is found to be slightly larger than the minimum with fields excited (from curve $C C'$), and considerably smaller than the maximum at the peak. So that the formula gives an e.m.f. which, checked by many tests, is slightly high, and, therefore, safe. Since in revolving-field alternators the armature reaction is the predominating factor in regulation, small variations in the calculated self-inductive e.m.f. are unimportant. In the inductor type of machine, however, the self-inductive e.m.f. is a more prominent factor and must be checked more carefully.

Armature reaction.—The combined effect of the armature reaction or back ampere-turns may be most conveniently calculated by a formula deduced by Steinmetz,[3] which is as follows:

M = number of phases,
I = current per phase or turn,
T = turns per pole per phase,
K = a constant depending on the distribution of the windings, and equal to the average cosine of the angle of spread. If ψ_1 is this angle,

$$K = \frac{1}{\psi_1}\int_{Y_1}^{0} \cos\psi\ d\psi.$$

Measuring this angle from center to center of the outside coils per phase per pole, the following values of K are obtained:

Slots per pole.	No. of phases.	K.
4	2	.900
6	2	.827
6	3	.954
12	2	.737
12	3	.900
15	3	.887
24	3	.866
∞	2	.637
∞	3	.827

The value, then, of the armature reaction is:

[3]Elements of Elec. Engineering.

$$Arm.\ Reac.\ (amp.\text{-}turns) = -\frac{M}{2} I T \sqrt{2K}. \qquad (3)$$

Having thus obtained, by the preceding formulæ (1), (2) and (3), the resistance drop, e.m.f. of self-induction, and the armature reaction, the necessary counteracting field ampere-turns are determined by combining them as vectors in the proper phase relation, as in Fig. 4.

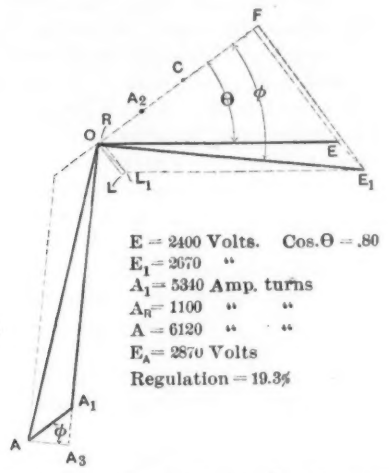


FIG. 4.—VECTOR DIAGRAM OF E.M.F'S AND CURRENT.

Here let

$O E$ = terminal voltage = E,
$E O F$ = angle of current lag or power factor angle = Θ,
$O C$ = armature current,
$O R$ = $I R$ drop component, in phase with $O C$,
$O L$ = $\omega L I$ or inductive drop component, 90° in advance of $O C$,
$O L_1$ = resultant of $I R$ and $\omega L I$,
$O E_1$ = resultant of $O L_1$ and $O E$ = internal e.m.f., or E_1,
$O A_1$ = amp.-turns (read from saturation curve) for $O E_1$ and 90° in advance of $O E_1 = A_1$,
$O A_2$ = amp.-turns of armature reaction, in phase with $O C$,
$A_1 A = O A_3$ = amp.-turns to oppose armature reaction,
$O A$ = resultant of $O A_1$ and $A_1 A$ = total amp.-turns excitation = A.

The angle $\phi = A_1 A A_3 = E_1 O F$; therefore,

$$\sin \phi = \frac{E_1 F}{O E_1} \quad \text{and} \quad \cos \phi = \frac{O F}{O E_1}.$$

The e.m.f. for the ampere-turns $O A$ is read from the saturation curve and gives the required open-circuit voltage with full field excitation. The difference between this e.m.f. and the terminal full-load e.m.f. is the rise in voltage which determines the regulation. Briefly, without the diagram the regulation is calculated as follows:

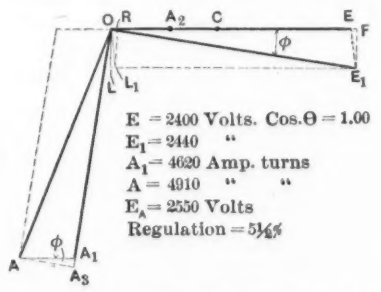


FIG. 5.—VECTOR DIAGRAM AT $\cos \Theta = 1$.

Given terminal voltage E, power factor = $\cos \Theta$, and saturation curve, and by calculation or test, $I R$ drop, $\omega L I$ drop, armature reaction = A Then

$$E_1 = [(E \cos \Theta + I R)^2 + (E \sin \Theta + \omega L I)^2]^{1/2}$$

A_1 = amp.-turns from saturation curve for E_1,

A = total amp.-turns = $[(A_1 + A_r \sin \phi)^2 + (A_r \cos \phi)^2]^{1/2}$

where $$\sin \phi = \frac{E \sin \Theta + \omega L I}{E_1},$$

$$\cos \phi = \frac{E \cos \Theta + I R}{E_1},$$

E_a = open-circuit voltage from saturation curve for A.

Special forms of the vector diagram occur at unity and at zero power factors. These are shown in Figs. 5 and 6, respectively.

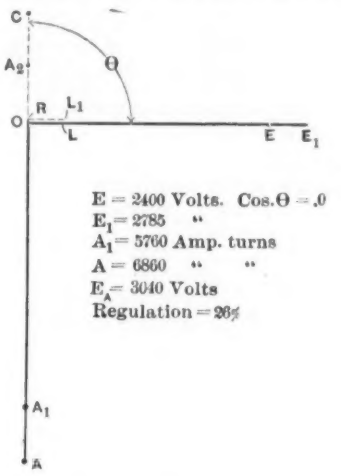


FIG. 6.—VECTOR DIAGRAM AT $\cos \Theta = 0$.

In Fig. 5 for unity power factor:

$$E_1 = [(E + I R)^2 + (\omega L I)^2]^{1/2}$$
$$A = [(A_1 + A_r \sin \phi)^2 + (A_r \cos \phi)^2]^{1/2},$$

where $$\sin \phi = \frac{\omega L I}{E_1} \quad \text{and} \quad \cos \phi = \frac{E + I R}{E_1}.$$

In Fig. 6, for zero power factor, $I R$ may be neglected and

$E_1 = E + \omega L I$,
$A = A_1 + A_r$.

Take for an example the alternator from which the curves of Fig. 3 are taken. The dimensions of the machine, necessary to calculate the regulation, in addition to those already given, are:

I = armature current = 52.1 amp.,
R = resistance of armature = .359 ohms at 60° C.,
$I R$ drop = 19 volts,
Cp = armature conductors per pole per phase = 36,

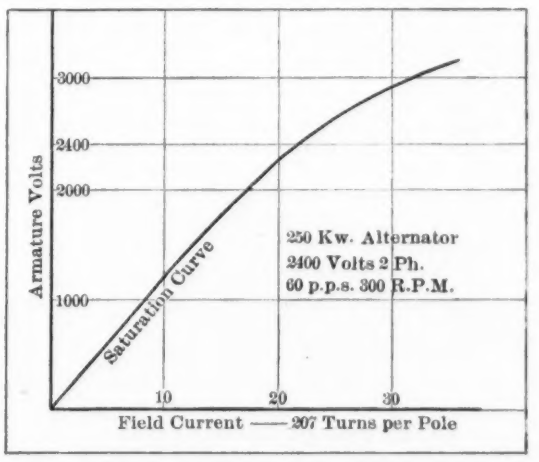


FIG. 7.—SATURATION CURVE OF 250-KW ALTERNATOR.

P = number of poles = 24,
Z_1 = 9.5 × .55 = c.g.s. lines per inch,
l_1 = length of iron = 8.5 inches,
l_2 = " free ends per turn = 37 inches,
n = number of coils per slot = 2,
L = .0196 henrys,
$\omega L I$ = 385 volts,
T = armature turns per pole per phase = 18,
K for armature reaction = .827.

Armature reaction = 52.1 × 18 × 1.414 × .827 = 1,100 amp.-turns. Saturation curve as per Fig. 7.

At power factor = 1.00:

$E_1 = (2{,}419^2 + 385)^{1/2} = 2{,}440$ volts,

$A_1 = 4{,}620$ amp.-turns, $\sin \phi = \frac{385}{2{,}440} = .158$,

$\cos \phi = \frac{2{,}419}{2{,}440} = .991$.

$A = [(4{,}620 + 174)^2 + 1{,}090^2]^{\frac{1}{2}} = 4{,}910$,

$E_A = 2{,}550$ regulation calculated $= 5\frac{1}{2}$ per cent.; from test $=$ 5 per cent.

At power factor $= 0$:

$E_1 = 2{,}400 + 385 = 2{,}785$,

$A_1 = 5{,}760$,

$A = 5{,}760 + 1{,}100 = 6{,}860$,

$E_A = 3{,}040$ regulation calculated $= 26$ per cent.; from test $=$ 24 per cent.

In the design of some thirty alternators, in which this combined method of calculation has been used, the rise in voltage has not varied on test more than 10 per cent. from that predetermined from the design. In most cases it has been considerably closer. In a very few cases the method has given regulations slightly lower than the test, but usually the predetermined value has been higher. That is, the regulation as calculated was poorer than it proved on test. This is a precautionary fault.

In some machines, also, when the calculated saturation curve did not check with the actual, as is sure to happen occasionally due to bad iron or miscalculated magnetic leakages, the regulation has been faulty. But with adjustment of the air-gap to give the proper excitation, the regulation has tested as calculated.

Location of Electric Stations.

BY ALTON D. ADAMS.

ELECTRICAL supply stations were started in business centers, but are rapidly moving to river banks and seashores. During the first decade of electric lighting the prevailing idea in the location of generating stations seems to have been nearness to connected loads. To accomplish this object stations were generally built on expensive land near the business centers of cities and towns, where water could be drawn only from the public mains, and where fuel and ashes could be transported only in carts. In almost every city of New England one or more early stations were thus located.

A good example of this practice may be seen to-day in the original Edison station at Lawrence, which still carries regularly its load of lamps and motors. This station was located, in 1882, on one of the main streets close to the business center of the city, and continues to operate with the old-time equipment of small bipolar Edison dynamos belted to high-speed engines. Every pound of coal must go to this station in carts, and any attempt to substitute compound condensing engines for those of the single-cylinder type would be met with the objection that water can be had only from the city mains.

At Portland, Maine, the first public lighting plant, installed early in 1882, was located in the main business section of the city. The same year saw public lighting plants installed in Lowell, Lynn and Springfield, not one of which was so located as to secure direct rail or water transportation of fuel, or with access to cheap condensing water. Moving from its rented space in a mill the lighting plant at Lowell, in 1883, was installed in a building on Middle Street, now used for the manufacture of cigars. From its first home, in a shoe factory on Market Street, in Lynn, the electric plant was moved to a station on Stewart Street, where cheap transportation and free condensing water were equally lacking. The Springfield plant of 1882 was located in a basement in the business section of the city at a good distance from both the railway and the river. The Edison station built at Fall River, in 1883, was located on one of the main business streets, and the same spot is now occupied as the office of the present electric system. At New Bedford the Edison station of 1884 was located on Middle Street, near the corner of Purchase, far from river and railway, and here again the present business office of the electric system is now on the site of the old generating plant. Aborn Street, in the business district, was the site of the first electric station in Providence, R. I., and this station depended on fuel transported in carts.

Boston presents a notable instance of the former tendency to locate electric lighting stations without regard to cheap supplies of fuel and water. Of the eight lighting stations operated in Boston before the end of 1888 every one was well removed from the railways and the harbor front. Beginning in the year 1883 the Brush lighting plant was located successively on Portland, Lancaster and Ferdinand Streets. In the same year a plant of Thomson & Houston arc dynamos was started in the basement of Mechanics' Building, on Huntington Avenue, for public service, and two years later this plant was moved to 197 Congress Street. Another station located on Stanhope Street began operation at Boston in 1884, and was equipped with Weston dynamos. The first Edison station in the city was located in Head Place and began operation on February 20, 1886. This station was then, as now, in the midst of a hotel and retail section of the city and made a rather long haul of fuel necessary. A little more than a year later, December, 1887, the second Edison plant was started on Hawkins Street, a site no better than the first as to cheap transportation of fuel or free water for condensing engines.

The completion of this Hawkins Street station may be said to close the era during which eight plants, three using Brush, two using Thomson & Houston, one using Weston and two using Edison apparatus, had been located at points about the city where all fuel must be hauled in carts and all water must be bought. The next station reversed this policy. By a consolidation, in 1887, the Brush, Thomson & Houston and the Weston systems passed into the hands of the newly-organized Boston Electric Light Company, and on December 31, 1888, that company started its new station at Gilman Place and Summer Street, on Fort Point Channel. This station was the first in Boston, and probably in New England, to secure free water for condensing engines and to take its coal directly from ships.

When, in 1891, the loads on the Edison system made a third station necessary, the lead of the Boston company was followed and the new plant was located on Atlantic Avenue and the harbor front, at the foot of Pearl Street, within less than a thousand feet of the Gilman Place and Summer Street station. This third Edison station was started late in 1892, soon assumed the greater part of the load on the system, and continued to do most of the work down to the purchase of the system of the Boston Electric Light Company by the Edison Company, in 1901.

The two stations last mentioned, of 1888 and 1892, solved the problem of free condensing water and cheap transportation for fuel, but the land about them had so high a value as seriously to burden their future expansion. A way out of this difficulty was sought by the Boston company in 1898, ten years after the Summer Street station was built, by the erection of their L Street plant, at South Boston, on land formerly occupied by the Harrison Loring shipyard, and having a long harbor frontage.

Purchase of the Boston system by the Edison Company, in 1901, carried with it this L Street plant, and the further purchase of some adjoining land provided ample room for expansion and for a large coal storage yard. Starting in 1883, in the heart of the business and residential districts of Boston, it took nearly a decade for electric lighting stations to reach the harbor front at points where real estate has high values for commercial purposes. The last ten years has witnessed the further movement of the main generating stations of the Boston system out on the harbor lines to a point where the price of land permits their construction to be carried out on the most approved lines.

In other cities a similar movement toward cheap land with free condensing water and direct boat or rail transportation has been made by electric stations. At Providence, R. I., instead of the two inland stations that formerly carried the lighting load, the work is now done by a single plant on the water front. The station at Newport, in the same State, is supplied with fuel from vessels at its own wharf. To the lighting plant at New Haven, Conn., both coal and condensing water come by way of the harbor, on which it is located.

Though transmitted water power supplies most of the electric energy distributed at Hartford, in the State just named, the construction of a new station on the bank of the Connecticut River is now under way to provide what steam power is wanted by the system. In Springfield, Mass., the basement plant of early years long since gave place to a station with the railway at one side and the river last named on the other. Even this well-located steam station does only a small part of the work of the system, for most of the distributed energy is transmitted from water power. Following the same river right across the State brings one to Greenfield, which,

though only a town, has its lighting station in the outskirts, with a pond of condensing water and a railway line on opposite sides.

The steam-driven plant at Lowell that carries the entire load of the electrical supply system there receives its coal in railway cars that run to the door, and pumps water for its condensing engines from the Concord River, on whose bank it stands. At Lawrence, though the old Edison station previously mentioned is kept at work, the later plant, driven partly by steam and partly by water power, stands on the bank of the Merrimac River and close to the railway.

The Haverhill station is on the water front of the same river, but is driven entirely by steam power. Still farther down stream, at Newburyport, the old station of 1887 that draws water only from the city mains is just being replaced by a new plant on a site where water for condensing is pumped from driven wells. At New Bedford the machinery from the Edison station in the midst of the retail district has been moved to a later plant on the river front, where condensing water is free and coal comes by the shipload. Similarly the lighting plant at Fall River has moved from the center of the business section to one side of the city, where a pond furnishes free condensing water. To the Lynn station on the water front coal comes by the shipload.

In all of the stations above mentioned, save that on the river front at Lawrence, steam is the only prime-mover, and the changes of location have been made to take advantage of free condensing water, cheap land or a low cost of transportation for fuel. In not one of these cases, so far as can now be recalled, has the change of location resulted in the substitution of water from some other source for that from city mains to feed the steam boilers. No doubt there are exceptional cases where such substitution has been made, but they are far from the general rule. The reason for the continued use of city water in boilers even where other sources of fresh water are available is no doubt the greater purity of the former and the consequent freedom from boiler incrustations. At many stations the charge made for city water is a very small item in the expense of operation, because of the fact that the condensed steam is pumped back into the boilers and only a slight amount of waste and leakage has to be made good from the city mains.

Besides the general movement of electric stations away from business centers to cheap land along railways or on river or harbor fronts in order to keep down investments in real estate and to reduce expenses for fuel and water, there is another important reason for changes in the locations of generating plants. This is the substitution of water power for steam. In order to make this substitution it is, of course, necessary to take the generating plant to the water power site and to rely on electrical transmission to deliver the energy at the distribution area. Some distinction may here be taken between great transmission systems that exist independently of any of the cities that they serve and those smaller developments of water power that are primarily designed to replace existing steam plants in particular cities. In this latter class may be mentioned the water power plant about three miles from the center of Burlington, Vt., that has entirely displaced the former steam-driven station in that city. Another similar example may be seen at Manchester, N. H., where the steam station adjacent to both railway and river has been in the main displaced by four water power plants ranged about the city and from three to fourteen miles distant. At Concord, in the same State, a like fate overtook the steam power plant some years ago and the load of the electric system was transferred to a water-driven station several miles above on the Merrimac River. In Springfield, Mass., most of the load of the electrical supply system is no longer carried by the steam station on the water front, but instead by two water power plants that are five to six miles distant.

Generating stations in the business centers of cities have often disappeared as such only to reappear at once as sub-stations. This is true both as to plants that have been displaced by better located steam stations and as to those that have transferred their loads to water power. Almost every objection that can be urged against the location of a generating plant in a business section of a city fails when applied to an electric sub-station. Even in the matter of land values the sub-station requires but a small investment in comparison with the steam plant, because of the far greater capacity per unit of ground area and space in the former. Not infrequently the formerly main generating plant of a system after its conversion into a sub-station does duty also as an auxiliary steam plant to carry the peak of the load or even more when water power is low.

In Hartford the Pearl Street plant, which at one time developed most of the energy used in the electric system by steam power, now serves as a sub-station to receive the transmitted outputs of two water powers that supply most of the current distributed in that city. Besides its work as a sub-station, the Pearl Street plant develops whatever energy the system requires from steam power.

The well-located steam station in Springfield, Mass., is now used mainly as a distributing center for the transmitted current that comes in from the two water powers of the system, but its engines are operated when occasion requires. A similar condition exists at the steam plant of the Manchester (N. H.) system, which operates alternately as a generating and a receiving station, according to the amount of available water power at the four other stations that connect with it by transmission lines. Where a more or less distant water power takes up the work of a steam-driven station, the steam plant is seldom moved to the site of the water power, though this is done in a few instances. A case in point is that at Burlington, Vt., where the water power station, distant about three miles from the business center, contains also the steam plant of the system.

Even where an existing steam-driven station is not so centrally located as to make it a very desirable distributing point for transmitted water power, there is a strong tendency to use it for this purpose when such water power is adopted. Much justification for this practice is found in the fact that all distribution lines usually radiate from such stations. Both Albany and Troy, N. Y., illustrate this practice, for in each of these cities a steam-driven electric station that is far from central now serves as the distributing point for energy transmitted from Spier Falls on the Hudson River.

Water power plants that are quite near to the cities they supply with electric current usually have their energy distributed through sub-stations. Thus at Concord the water power is only three miles up stream from the sub-station that distributes current in the city. At Lewiston, Maine, the new water power plant is three miles by the line from the old plant that serves as a sub-station in that city. Bangor, in the same State, draws its electric energy from a water power about four miles from the sub-station that distributes it to consumers. In some cases a steam power station has been so far removed from the business center of the city which it is mainly intended to supply that distribution through one or more sub-stations there was necessary, but this is not the general rule.

There is a growing number of instances, however, where the steam-driven electric station near a rather large city delivers current for distribution through more or less distant sub-stations in surrounding towns. This practice may be noted at Lowell and North Adams, Mass.; Providence, R. I.; Hartford and New Haven, Conn., and particularly about Boston, whence lines to suburban towns run out some twenty-five miles. With the highly concentrated loads of great cities the removal of generating plants to points where transportation of fuel is easy, land cheap and condensing water free, is apt to make sub-stations in the business districts very desirable. Boston illustrates in a rather striking way the importance of sub-stations in three-wire, 250-volt distribution, for in that part of the city between Massachusetts Avenue and the harbor there are six sub-stations. This section is about 2.25 miles long, a little more than one mile wide and includes the most densely populated residential portions as well as the main business area of the city. Included in this enumeration of sub-stations are the plants at Head Place, Hawkins Street and Atlantic Avenue, all three of which were first designed to operate with steam power.

The plants at Head Place and Hawkins Street long since ceased to develop electrical energy from steam, and now serve merely for distribution purposes. Though the L Street station in South Boston now develops the greater part of the current used in the system, the Atlantic Avenue plant still does a large amount of generator work, and also operates as a sub-station receiving current from L Street. Before the purchase of the Boston electric light system by the Edison Company, the Atlantic Avenue station of the latter was doing nearly all of the generator work of its system and sending its current to Head Place and Hawkins Street, Scotia and Canton Streets for distribution.

Looking backward at the locations of early lighting stations, it is now easy to see that the importance of small line losses was much exaggerated. The majority of the pioneer plants began business with arc dynamos, whose full-load pressures ranged from 1,000 to 3,000 volts, or with alternators of about 1,000 volts, and yet these plants were usually crowded into the center of business districts, as

were those of lower pressure. Even with the 500-volt dynamos that were introduced a little later for power service the current might easily have been distributed directly to motors from stations favorably located as to coal, water and land values.

As to the early Edison systems, at 250 volts, it is evident that the sub-station idea was as applicable in 1883 as it is now, if its utility had then been appreciated. The first Edison station in Boston might, with advantage, have been on Atlantic Avenue instead of at Head Place, and might have transmitted its current to sub-stations for regulation and distribution just as is done now.

These suggestions carry no reproach to the engineers of these early plants, for they were leaders in their day, and on their work the foundations of electrical supply were laid.

A Physical Conception of Some Alternating-Current Phenomena.—II.

By Lamar Lyndon.

CONDENSER.

If an e.m.f. be impressed at the terminals of a condenser, current will flow into it, and as the current is stored up, the condenser e.m.f. will rise, opposing the incoming current until a point is reached at which the condenser e.m.f. is equal and counter to the impressed e.m.f. When this condition is attained no further current passes into the condenser, and consequently the point of zero current flow corresponds to the maximum condenser e.m.f.

Also, it is obvious that the rate of current flow into the condenser on charge is proportional to the difference between the impressed e.m.f. and condenser e.m.f., which opposes the current. When an alternating e.m.f. is impressed on a condenser, current flows into it most rapidly when the condenser e.m.f. is zero, as it sets up no opposition to current flow, and the value of the impressed e.m.f. is such that at this point the greatest difference exists between the impressed and the condenser e.m.f's. Hence, the condenser e.m.f. is zero at the instant when the current in the circuit is a maximum. When full charge and maximum condenser e.m.f. are reached and current ceases to flow, the impressed e.m.f. begins to decrease and falls below that of the condenser, which latter then discharges into the circuit. The action is clearly shown by the curves in Fig. 5.

As in the case of the before-mentioned inductive circuit, the current flow is always in proportion to and in phase with that e.m.f. which is the resultant of all the e.m.f's acting on the circuit. Calling the curve i, i, i, i the amplitude and phase of the current, v, v, v, v is the phase and, to some convenient scale, the amplitude of the resultant e.m.f. When the current is zero—as at Z—the condenser is fully charged, its e.m.f. being equal to that of the impressed e.m.f. at this point. The difference between the two being zero, the current

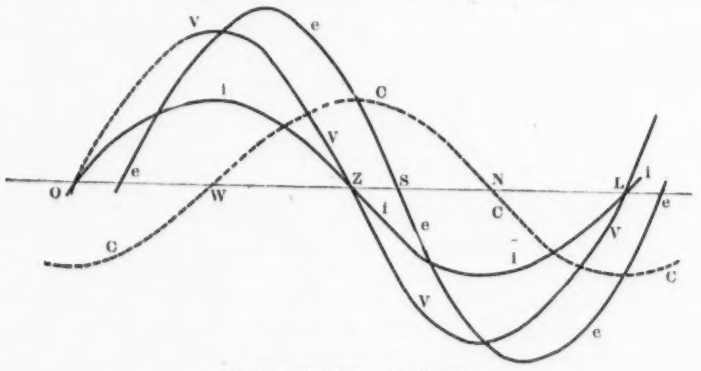


FIG. 5.—CONDENSER CURVE.

flow is zero. As, immediately on passing this point, the impressed e.m.f. falls below that of the condenser and the latter begins to discharge, thereby lowering its voltage, the point of zero current flow is the point of maximum condenser e.m.f.

From W to Z the condenser is being charged. From Z to N it discharges. From W to Z the condenser e.m.f. increases, as shown by C, C, C, C, the curve of condenser e.m.f. Drawing C, C, C, C so that its maximum is coincident with zero current flow, and its zero coincident with maximum current flow, it is evident that the condenser e.m.f. is ¼ period, or 90° *ahead* of the current flow.

The summation of the e.m.f. curves, V, V, V, V and C, C, C, C, gives curve e, e, e, e, which is the impressed e.m.f.

The addition of this curve makes the explanation somewhat clearer.

At W, e is greater than C by the maximum amount, and consequently the greatest current will flow, as is shown by curve i. The difference between e, e, e, e and C, C, C, C constantly decreases and the current flow, therefore, diminishes as is indicated by curve i, i, i, i, until point Z is reached, at which e, e, e, e is equal to C, C, C, C, and the current flow is zero. Passing point Z, the impressed e.m.f. still further decreases and the condenser begins to discharge, the current now flowing in the opposite direction. As discharge proceeds the condenser voltage falls off, until at point N its e.m.f. is zero. Before point N is reached, however, the impressed e.m.f. reaches zero—say at S. Up to the time of reaching zero the impressed e.m.f. has opposed the condenser discharge, and the current flowing has been due to the net e.m.f., which is the difference between these two e.m.f's. When the impressed e.m.f. becomes zero the condenser e.m.f. is no longer opposed, and when the impressed e.m.f. passes through zero it acts with the condenser e.m.f., assisting the latter to send current through the circuit. When the condenser e.m.f. reaches zero, the impressed e.m.f. has risen to such a value that the maximum current flows into it, but oppositely to the direction in the first half of the cycle, and the condenser begins to charge

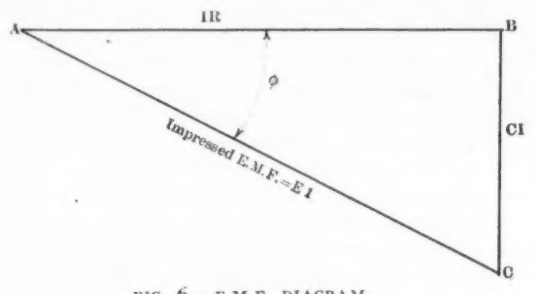


FIG. 6.—E.M.F. DIAGRAM.

in an opposite direction, charge continuing until the point L is reached, when the current becomes zero, and the condenser e.m.f. a maximum. The cycle then is repeated as before.

From this it follows that (1), the impressed e.m.f., is the sum of the active or resultant e.m.f. and the condenser e.m.f.; (2) the condenser e.m.f. reaches its maximum value ¼ period ahead of the resultant e.m.f., or, reckoned in terms of armature rotation, 90° (= ¼ revolution) ahead of the resultant e.m.f., and (3), that the resultant e.m.f., and consequently the current, is in advance of the impressed e.m.f., but behind the condenser e.m.f.

Since the condenser e.m.f. is 90° ahead of the resultant e.m.f., a diagram similar to Fig. 4 may be used for computations.

In Fig. 6 the horizontal line, AB, represents to scale the effective value of the resultant voltage $= IR$. CI is the effective value of the condenser voltage, laid off downward, to show that it is in opposition to inductance, which latter being 90° behind the resultant e.m.f. is 180° behind the condenser e.m.f., and therefore in exact opposition thereto.

ϕ is the angle of lead and its tangent is obviously $\frac{CI}{RI}$ or $\frac{C}{R}$.

The cosine of the angle ϕ, which is seen to be $\frac{R}{\sqrt{R^2 + C^2}}$, is the circuit "power factor," which term will be treated at some length below.

The value of the voltage set up at the terminals of a condenser due to the passage of current into it is computed as follows:

By definition a capacity of one farad will allow the storage of one coulomb, with one volt impressed on the condenser terminals. The quantity stored varies as the maximum e.m.f. impressed, while one coulomb stored in a condenser of one farad capacity is at one volt constant pressure, such as a continuous-current dynamo or a battery would deliver. One volt constant pressure is the same as the average of the voltage taken over any length of time. The average of a sinusoidally-varying pressure is .6366 the value of the maximum. Therefore, for an *average* e.m.f. of one volt alternating, the coulombs

$$\text{stored} = \frac{1}{.6366} = 1.57 \text{ coulombs.}$$

Since a condenser is twice filled and twice emptied during one cycle, the quantity of electricity it receives on charge passes four times through the circuit, and for one cycle at one volt effective

e.m.f., $4 \times 1.57 = 6.28$ coulombs are stored in a condenser of one farad capacity if the current follows the sine law. As one coulomb per second is one ampere, if the frequency be one cycle per second, 6.28 amp. will flow through the condenser. From which it is plain that $I = 6.28 \times f \times E \times J$ (10)

When the relations of sine functions are investigated trigonometrically, the coefficient which appears in the foregoing as 6.28 shows as 2π, and the usual formula for condenser current is $I = 2\pi f J E$, from which

$$E = \frac{I}{2\pi f J} \qquad (11)$$

which is the *effective* e.m.f. required at the terminals of a condenser of a capacity $= J$ to pass the effective current, I, through it. The farad is much too large a unit for practical use and the microfarad, or one millionth of a farad is generally used. Calling this Jm, formula (11) becomes

$$E = \frac{I \times 1{,}000{,}000}{2\pi f Jm} \qquad (12)$$

As an example, take the case of a circuit having in it a resistance = 8 ohms and a capacity = 50 microfarads. Frequency of impressed e.m.f. = 100 cycles per second and effective voltage 100.

From the Fig. (6)

$$EI = \sqrt{(IR)^2 + (CI)^2} \quad \text{or} \quad E = \sqrt{R^2 + C^2} \qquad (13)$$

C being the reactance of the condenser.

From equation (12) the voltage at the terminals of a condenser is $Ec = \dfrac{1{,}000{,}000}{2\pi f Jm}$ for one ampere (effective) flowing through it.

Whence,

$$\sqrt{R^2 + \left(\frac{1{,}000{,}000}{2\pi f Jm}\right)^2} = \sqrt{(8)^2 + \left(\frac{1{,}000{,}000}{6.28 \times 100 \times 50}\right)^2}$$

$= 32.82$ volts for each ampere flowing through the circuit. Current $= \dfrac{100}{32.82} = 3.05$ amp. Tangent angle of lead $= \dfrac{\frac{1{,}000{,}000}{2\pi f Jm}}{R} = \dfrac{31.83}{8} = 3.98$, corresponding to an angle of 75° 54″.

WATTS OUTPUT.

It is evident that the actual watts supplied to an alternating-current circuit are the product of the resultant or active e.m.f., multiplied by the current flow, and not impressed e.m.f. × current, except in those cases where the impressed e.m.f. coincides in phase position and magnitude with the resultant e.m.f.

The impressed e.m.f. is greater than the resultant by an amount sufficient to pass current into a condenser or through an inductance; but this excess does not represent energy supplied continuously. Inductances and condensers merely store up energy and the excess given up during one portion of the cycle is returned to the circuit at some other portion of the cycle.

It is customary to speak of "wattless current" in circuits where there is a phase displacement, when, in reality, there is no such thing possible in practice, as current is wattless only when the resultant e.m.f. of the circuit is zero. An alternating e.m.f. impressed across the terminals of an inductance would result in the flow of wattless current if the entire circuit were without resistance. Since there is resistance in every circuit, there can be no wattless current; but if the inductive e.m.f. be very great and the resistance very small nearly all of the impressed e.m.f. will be used up in overcoming the opposing inductive e.m.f., and the net useful or resultant e.m.f. is so small that a large current flow is necessary to produce any appreciable output in useful watts. As an example, if there be an inductance in a circuit which has an impressed e.m.f. of 100 volts, and the resultant or active e.m.f. is 90 volts, to deliver 10 kw will require 111.1 amp. If the inductance were not present, the impressed e.m.f. would also be the active e.m.f., and to deliver 10 kw would require 100 amp. The difference between these two or 11.1 amp. is the increase in current required to deliver a given output due to the decrease in net useful voltage. The *apparent* watts delivered are $100 \times 111.1 = 11.1$ kw; but this amount of energy is neither generated nor supplied, and since there appears to be more current than is necessary to produce the output, it has become customary to term part of the current "wattless," a designation which has no

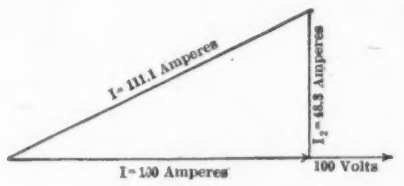


FIG. 7.—CURRENT DIAGRAM.

foundation in fact. It is convenient, however, in certain alternating-current problems, to consider the impressed e.m.f. as the net useful voltage and to separate the current into two components, one being the useful component in phase with the e.m.f., the other at 90° to the e.m.f. Thus, in Fig. 7, if 100 volts are impressed on the circuit and the amperemeter shows 111.1 amp. passing through it, while the delivered power is actually 10 kw, it may be assumed that 100 amp. of the current are in phase with the e.m.f., while 48.3 amp. are at 90° to the e.m.f., and this 48.3 amp. is the wattless component of the current flowing. All this is a mathematical fiction which has no physical existence and is misleading unless it be recognized as simply an artificial method of computation.

Referring to Figs. 4 and 6, it is plain that the active or resultant voltage which does useful work in the circuit and represented by the horizontal line, IR, is equal to the impressed e.m.f., multiplied by the cosine of the angle of lead or lag—the impressed e.m.f. being equal to the length of the hypothenuse of the right triangle.

In the example given in the first installment of this article, where the effect of a condenser of capacity = 50 microfarads, included in series with a resistance of 80 ohms, is discussed, the current at 100 volts impressed e.m.f., and frequency of 100 cycles per second, was found to be 3.05 amp., and the angle of lead 75° — 54″. The cosine of 75 ° — 54″ = .2438.

The actual energy, then, put into the circuit is $3.05 \times 100 \times .2438 = 74.36$ watts.

The cosine of the so-called angle of lead or lag is known as the power factor. This quantity multiplied by the impressed e.m.f. gives the resultant or active e.m.f.

This result may be obtained by combining the impressed and reactance voltages. Since $I = 3.05$ amp. reactance voltage $= \dfrac{1{,}000{,}000 \times 3.05}{\omega Jm} = 94.25$ volts. Resultant voltage $= \sqrt{E^2 - C^2}$ $= \sqrt{(100)^2 - (94.25)^2} = 24.4$ volts. Watts $= 24.4 \times 3.05 = 74.4$ watts.

The foregoing shows that large currents may often be required to supply a small amount of energy, because the resultant voltage is small where the reactances in the circuit are large. This current, however, is not hypothetical nor imaginary, and conductors sufficiently large to carry it must be provided for its transmission. The power loss in a line is always the square of the current flowing multiplied by the resistance of the circuit, and this so-called "wattless" current is no exception to the rule.

If, in the last example, 2 ohms were the resistance of the line, and 6 ohms the resistance of the receivers—say incandescent lamps—the line loss would be $(3.05)^2 \times 2 = 18.65$ watts, while the total energy supplied to the circuit is 74.46 watts, the percentage loss being 25 per cent. If there were no capacity in the circuit and the ohmic resistance were 32.83 ohms, the current would be 3.05; watts delivered to the circuit = 305, and the loss 18.65 watts, as before, the percentage in this case being 6.25 per cent. From which it follows that the energy loss in conductors is proportional always to the square of the current, regardless of phase, though the watts delivered to the terminals of a receiver are proportional to the current, impressed voltage and power factor. Under one condition the transmission of a certain amount of energy will result in a given loss. By changing the reactance in the circuit a smaller amount of energy may be supplied by a greater amount of current, and a correspondingly greater line loss.

Steam Turbine-Driven Central Station.

Among the central stations now being put into operation, in which steam turbines are exclusively used as prime-movers, is the new station of the Citizens' Light, Heat & Power Company, at Johnstown, Pa. This station has been designed throughout for the use of steam turbines, and its construction presents a number of features of novelty and interest.

The city is at present served with electric supply by two power stations, both of which are operated by the Citizens' Company. One located on Vine Street is a 1,200-kw, engine-driven, direct-current, low-tension station, and the other, on Broad Street, is a 1,200-kw, turbine-driven, high-tension, alternating-current station. The former supplies a 110-volt, three-wire system serving the adjacent business and residential sections of the city, and the latter a 4,000-volt, four-wire, three-phase, alternating-current system, constituting the entire source of alternating-current supply throughout both central outlying districts. In addition to its direct-current supply, the Vine Street station also supplies exhaust steam to a large area covering practically the entire business district; the plant, therefore, runs non-condensing. No steam heating is attempted from the turbine station, which runs condensing, and which will handle all future increase in lighting and power load.

The turbine station at present labors under extremely light load, due to the fact that it has been but a short time in service, and shifting of the present load and contemplated extensions have not yet been carried out. At the present time a large rotary converter is being installed in the Vine Street station, which will operate as a link between the two systems. Under normal conditions, it will convert power from the alternating-current station to augment the supply from the direct-current station. It will be used mainly during the summer months, during which time steam heating will not be required, thus enabling a large portion of the direct-current equipment to be withdrawn from service, or vice versa. When the alternating-current load is extremely light or during emergencies, the rotary will be used to furnish the alternating-current supply.

Distribution from the turbine station is carried out with a four-wire Y-connected system, with 4,000 volts between outers and 2,300 volts between neutral and outers. The four-wire lines are carried directly from the station to supply heavy load centers and power circuits. Single-phase circuits are supplied directly from the switchboard, which is arranged so that the load may be shifted from one phase to the other in order to keep the system as nearly balanced as possible.

The power building, an exterior view of which is given in Fig. 1, is located at the corner of Broad and Tenth Street, and adjacent to the main line of the Pennsylvania Railroad. A spur track running upon a wooden trestle parallel to the boiler room wall is available for the coal supply. The building is a steel and concrete fire-proof

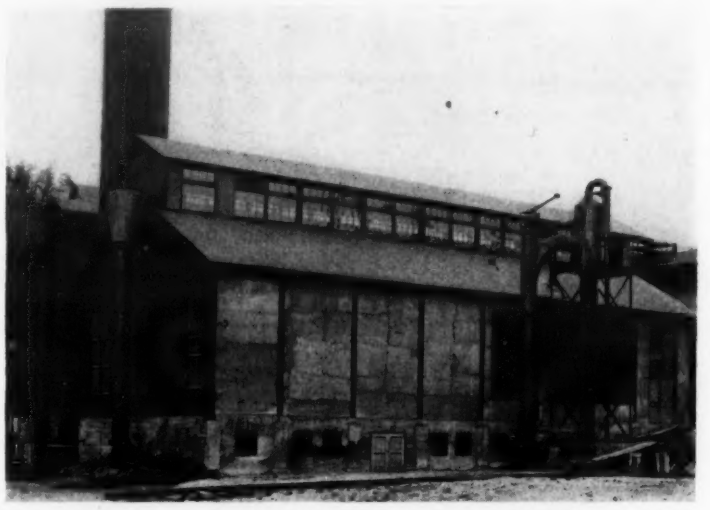


FIG. 1.—POWER STATION, SHOWING CONDENSER.

structure 108 ft. in length and 88 ft. in width. It is at present approximately one-half its ultimate size, and the south end is temporarily sealed so that extensions may be readily made in the future. The present equipment comprises 800 kw in turbo-generators and 1,200 hp in boilers. Extra space is available for a third turbine unit, but the boilers are already in place for three turbines, icluding one 300-hp reserve, while the chimney is of sufficient capacity to supply double the present boiler plant.

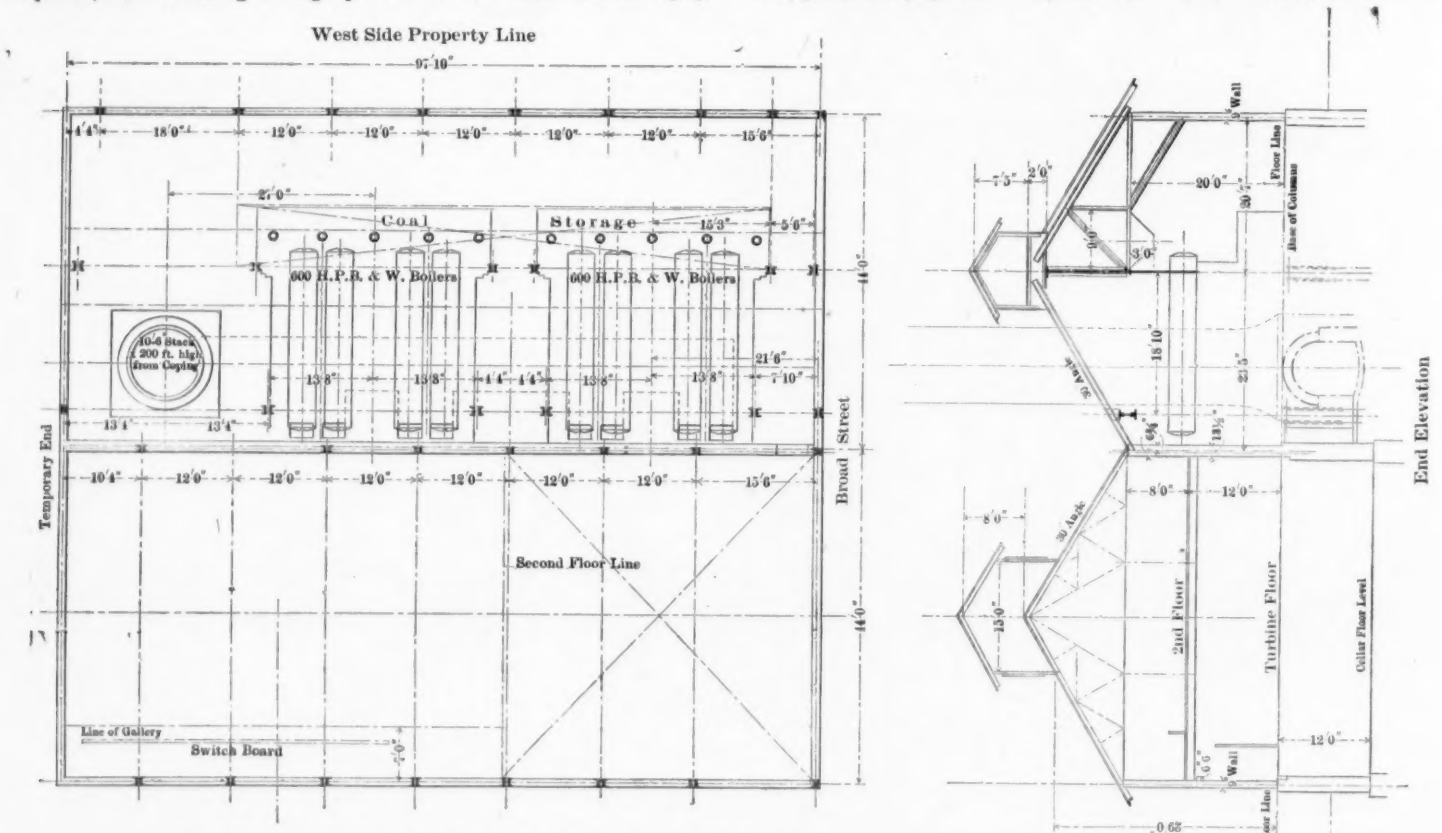


FIG. 2.—PLAN AND END ELEVATION OF ENGINE AND BOILER HOUSE.

The station now occupies 9,500 sq. ft. of floor area, equivalent to 5.9 sq. ft. per electrical horse-power capacity. The boiler equipment occupies 3.96 sq. ft. per boiler horse-power, or 2.95 sq. ft. per electrical hp. The generating plant, together with

switchboard, auxiliaries and condensing plant, occupies 2.25 sq. ft. per electrical hp, while the space required for the turbines and switchboard alone is 1.36 sq. ft. per electrical horse-power, with units spaced at 15 ft. centers. This spacing could be considerably reduced if necessary.

The building consists of a skeleton structure of steel work resting upon a concrete foundation with concrete side walls, steel roof trusses and slate roof. A brick partition divides the building into two approximately equal parts. In the turbine room a second floor or gallery 40 x 44 ft. is suspended from the trusses 8 ft. below the lower chords. and leaving a head room of 12 ft. on the main floor. In the boiler room a modified form of truss is employed. A line of latticed channel columns supports the central part of the trusses, one end of the boilers and one side of the storage bin. This bin is built into the trusses, which furnish the only support for the outer side. A monitor 15 ft. in width surmounting the roof of the turbine room provides light and space for conducting feeder wires from switchboard to pole line. A similar monitor in the boiler room gives the needed ventilation and accommodates the horizontal run of the coal-conveying system.

Floors and basement of both turbine and boiler rooms are concrete, the former being of steel-concrete arch construction. A 12-ft. basement below the turbines provides ample room for atmosphere and exhaust, steam and auxiliary piping. A tunnel 11 ft. square beneath the boiler room floor accommodates ash cars, which are run by hand to the dump.

The accompanying plan, Fig. 2, shows the general arrangement of turbine and boiler room. The location of the condenser is outside the building, as shown in Fig. 1, while auxiliary air and circulating pumps are placed in the basement. In order to decrease the lift required of the circulating pumps, this part of the equipment is located in a sub-basement 15 ft. below the engine floor level. In this position they draw their supply at about 10 ft. lift at low water from the Conemaugh river, which passes the power plant a short distance away.

Two turbine units are at present in operation, each of the Westinghouse-Parsons type, of 400-kw capacity (see Fig. 3). The tur-

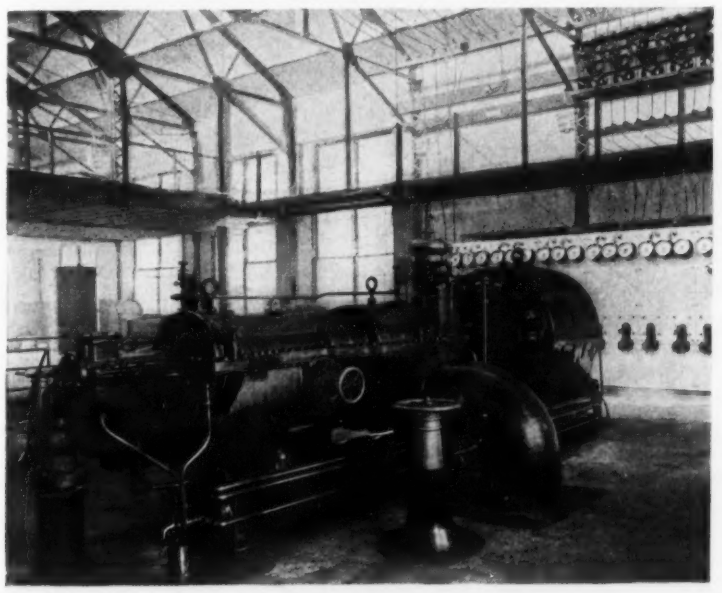


FIG. 3.—TURBO-GENERATOR UNIT.

bines receive steam from a 14-in. steam main beneath the floor, and discharge their exhaust through 20-in., 90° bends into the exhaust line in the basement, each discharge being controlled by a 20-in. outside screw and yoke valve provided with mitre gearing for operating from the floor above. The pedestals for these valves will be noted in photographs. Corrugated copper expansion sections relieve the stresses in piping and turbine casings. A separate atmospheric exhaust line connects with the opposite sides of the turbines through 20-in. valves, also controlled from the floor above. The foundations for the turbines consist of solid concrete piers with suitable footings. No foundation bolts are used, the bedplates having been simply flushed with concrete to secure an even bearing. Openings in each pier accommodate the two exhaust lines.

As the construction of the Westinghouse-Parsons turbine is so well known, only a few features having an especially important bearing upon its operation will be touched upon here. In general, the equipment is standard throughout. Each turbine is controlled by a sensitive governor of the fly-ball type, provided with special adjustment for paralleling the generators. The entire governor spring mount is held between two rows of ball bearings, so that this element may be brought to rest during the motion of the turbine. The speed may then be varied to a nicety by varying the tension of the spring. This enables the new machine to be brought up to speed and synchronized with the greatest ease, also providing means for distributing load between two or more machines. Synchronizing is accomplished with the aid of a Westinghouse round dial synchronizer on the switchboard, the usual lamps being, of course, also available as a precaution.

The turbine units run at the normal speed of 3,600 r.p.m. To absorb vibration while the turbine is passing its critical speed, the usual concentric shell journals are employed. At normal speed no vibration can be felt. These main bearings are continuously supplied with oil under slight head to insure thorough flushing. The oil is kept in circulation by a single-cylinder pump driven directly from a reciprocating arm geared to the shaft through a worm. Oil

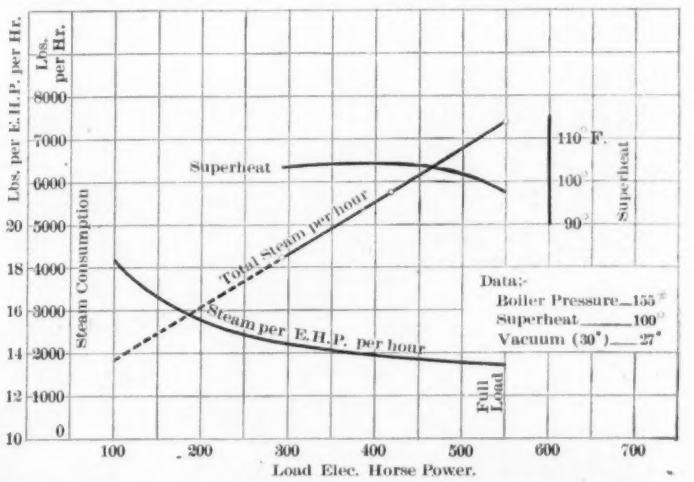


FIG. 4.—TEST OF 400-KW WESTINGHOUSE-PARSONS STEAM TURBINE.

is filtered once per month and about 2½ gallons replaced by fresh oil, the old oil then being used in other machinery.

ECONOMY TEST OF TURBINE.

Duration of test, 1 hour.

Load	E. H. P.	551.1	417.9	293.7
	Kw.	411.12	311.72	219
Steam pressure throttle		155.2	147.5	155
Vacuum	Actual	26.05	26	26
	Referred	27.05	27	27
Superheat, F°, Throttle		97.6	104.2	103.1
Speed, R.P.M.		3481.8	3508.7	3530
Total water, lbs.		7425	5780	4272
Steam per E. H. P. hour		13.47	13.83	14.54

Owing to the fact that the rotating parts are entirely supported by oil films, whatever heat is generated is due entirely to fluid friction. This is removed from the oil as it leaves the bearings by passing it through a pipe coil cooler located in the bedplate of the turbine. Recently the somewhat novel procedure has been adopted in this plant of drawing the supply of feed water for the boilers through the cooling coils of the turbines, thereby reclaiming the cooling water which would otherwise constitute a waste unless used for some other purpose.

At present the peak load upon the plant is far below even its normal capacity. Ultimately, however, overload capacity will become more necessary. In order to provide this capacity, the turbines are equipped with secondary valves, which admit high-pressure steam into an intermediate stage of the turbine. They are arranged for operation by hand and enable the machines to sustain an overload of over 50 per cent. when operating condensing, or full load when exhausting into the atmosphere.

Approximate dimensions of units are 18 ft. 10½ in. in length, 4½ ft. in width and 7½ ft. in height. The turbines are designed for operating at 160 pounds boiler pressure and 27-in. vacuum referred to 30-in. barometer.

Their performance under trial as determined in the testing floor of the boilers under the supervision of the company's engineer, is recorded in the accompanying table, and shown graphically in the accompanying curves, Fig. 4.

The generator is driven by a turbine through a flexible coupling, thus permitting its removal without disturbing the turbine adjustment. It is of the rotating-field type, separately excited. The field

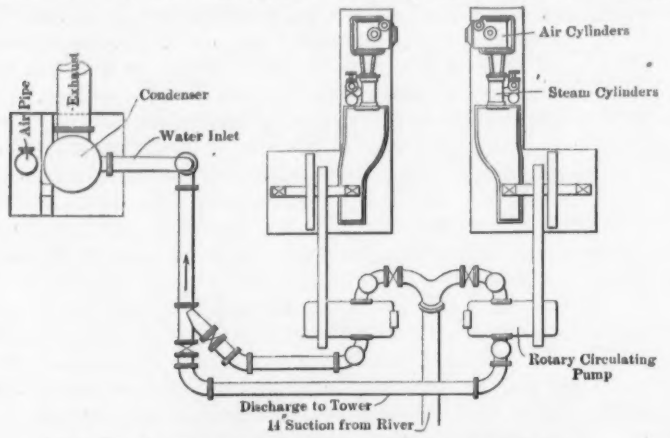


FIG. 6.—PLAN OF AIR PUMP ENGINES AND PUMPS.

is built from a solid steel forging slotted longitudinally for the reception of strap copper windings, which are firmly held in place by brass retaining wedges. Its periphery is turned smooth to reduce windage and noise. The armature is wire-wound, the neutral point being brought out to the terminal board.

A duplicate set of exciter units is provided, each of 25-kw capacity (see Fig. 5). One is direct-connected to an 8½-in x 8-in. Westinghouse Standard engine; the other to a 40-hp Westinghouse type C induction motor. Under ordinary lighting load, the motor-driven exciter is found to secure sufficiently good regulation to the system. The engine-driven exciter is, however, provided for relay purposes and for use during periods of heavily fluctuating loads. With the independent engine-driven exciter, the cumulative speed variations unavoidable with the motor-driven exciter are, of course, eliminated.

The selection of the Weiss barometric type of condenser for operating this plant was the outcome of an investigation into this subject by the engineers. The feed water supply is drawn from the city mains and is quite free from chemical impurities calculated to cause boiler encrustation. As water costs somewhat under 9 cents per 1,000 gallons, the expense for feed water is nominal. On the other hand, cooling water from the river is contaminated with impurities which would be liable to cause trouble in condenser tubes. These points, together with considerations of operating cost and maintenance, led to the adoption of the barometric type.

The condenser is located just outside the power house wall, somewhat nearer its auxiliaries than the turbines (see Fig. 1). It is supported upon a trussed steel tower, 9 ft. x 9 ft. x 29 ft. high, carried by a brick foundation, which also forms the hot well. Both the tail pipe and drip pipe from the air off-take are water-sealed in the hot well. Overflow water returns to the river through a tile conduit.

It is well known that in a condenser some provisions must be made for extracting from the condenser shell or cone the entrained air which is carried over in the feed water, and in the case of jet condensers, in the cooling water. Recent practice points to the use of an independent steam-driven air pump for this purpose. In this plant all auxiliary machinery is in duplicate. Each set has a capacity equivalent to two-thirds that of the plant. It consists of a dry air pump of the Weiss type, as shown in Fig. 6, coupled tandem to a horizontal single-cylinder steam engine, which also drives, through belting, a Bibus rotary water pump delivering cooling water to the condenser. A throttle governor equipped with a friction speed-changing device controls the speed of the engine, which has a simple unbalanced slide valve and runs non-condensing, the exhaust steam being used for heating the feed water. This arrangement is adopted as it insures considerable saving and renders unnecessary the use of a high duty engine for driving the auxiliary machinery, the latent heat of the steam used being largely returned to the boilers.

The rotary pumps are located in a pit several feet below the basement floor in order to reduce the suction lift. They draw water from the river through 740 ft. of 14-in. main, discharging directly into the condenser through a 12-in. riser.

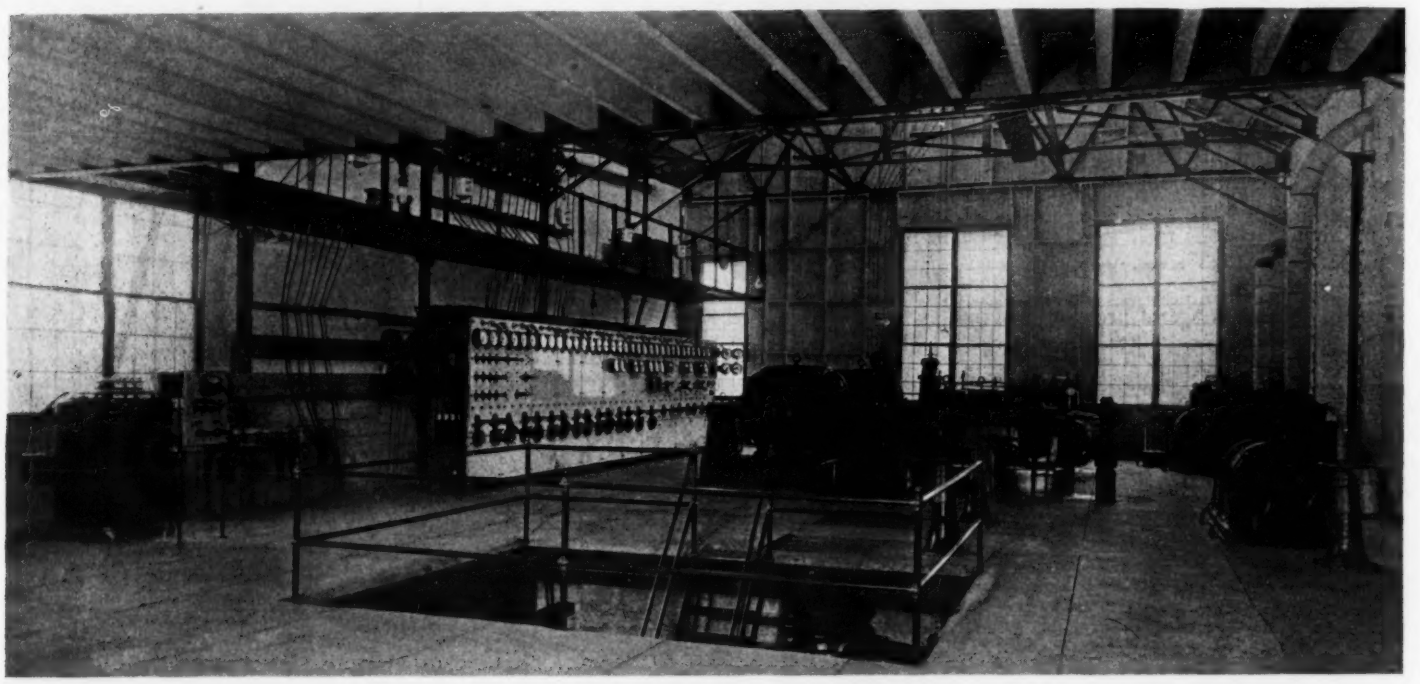


FIG. 5.—VIEW OF INTERIOR OF POWER STATION.

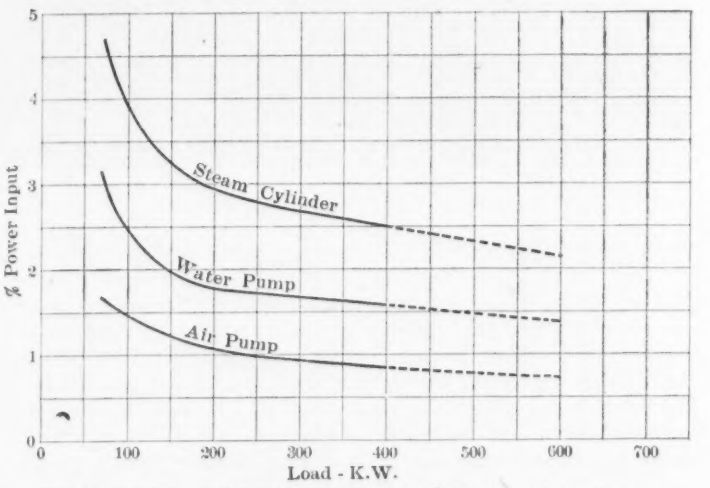


FIG. 7.—POWER CONSUMPTION OF CONDENSING AUXILIARIES.

The entire condensing equipment was designed and built by the Southwark Foundry & Machine Company, Philadelphia. It was guaranteed to handle 400 pounds of steam per minute with in-

jection water at 70° F., and to maintain a vacuum of 27 in., referred to 30-in. barometer, requiring under these conditions about 24 pounds of injection water per pound of steam condensed.

Tests recently conducted upon the condensing equipment, with the object of determining the power required under various conditions, reveal some interesting facts. Under the heaviest load, which was, however, but little over half load upon one turbine unit, the total indicated power in steam cylinder of the auxiliary engine, expressed in percentage of the total output of the generating units, was less than 3 per cent. At full load on one turbine the power put into the auxiliaries, as estimated from readings under present load, is 2.5 per cent. From observations taken at several loads, the auxiliary power input decreases in nearly inverse proportion to the load (see Fig. 7), and it is, therefore, probable that under full station load the power consumption would be less than 2 per cent. of the power delivered at the switchboards. These tests were carefully conducted and leave no doubt as to the fallacy of the widely accepted opinion concerning the large amount of power supposed to be consumed by auxiliaries. With a properly designed condensing plant, this power can be kept to a low figure, as here proven.

During the winter a vacuum of 28 in. has been readily maintained, and at the present time, with injection water at 75°, 27, 28-in. vacuum is readily maintained throughout the heavy load, which, however, is far below the rated load to be carried. The condenser and piping, both atmospheric and exhaust, is built of riveted sheet steel, calked under vacuum, with the exception of the free exhaust. Plain rubber gaskets are used with riveted flanges, and the ends of the pipe peened over. At the top of the 30-in. exhaust riser is a balanced atmospheric relief valve, set to open at a few pounds pressure. All exhaust piping is provided with long radius bends, intended to eliminate as far as possible the loss of vacuum between turbine and condenser, occasioned by friction and eddies in the somewhat circuitous path of the steam.

The operation of the boiler plant has been simplified to such a degree that at any one time two men can operate the entire plant. The coal is handled entirely by machinery, and the removal of ashes is, under the conditions, a simple operation. A notable feature in the design is the location of the steam header in the basement of the turbine room and the chimney flues beneath the boilers, thus doing away with the discomfort and crowding due to steel plate flues back or above the boilers. The compactness secured by this arrangement is well shown in the accompanying sectional elevation. Babcock & Wilcox boilers with forged steel headers are installed, each of 300-hp capacity, set two in a battery. They are suspended from steel girders resting upon latticed channel columns placed outside the boiler setting so as to be entirely free from heat stresses. No passageway in the rear of the boilers is provided; instead, ample sized doors opening into the rear through the sidewalls of the setting.

While repair work is being conducted, a heavy steel plate damper closes the draft opening to the main flue below. Each safety valve has its discharge piped upward through the roof in order to keep the boiler room clear of escaping steam.

Cambria semi-bituminous coal is used, obtained at a nominal figure from mines near by. A sample recently tested showed a calorific value of 14,600 B.T.U. per pound of dry coal, or 15,000 B.T.U. per pound of combustible, with 7 per cent. to 8 per cent. ash. In order to burn this fuel successfully, large combustion chambers are used built into the boiler setting and fitted with Murphy automatic inclined grate stokers. Coal gravitates as required from the bunkers above through 12-in. chutes, the controlling valve being usually left open. Ashes similarly gravitate into ash cars in the tunnel below.

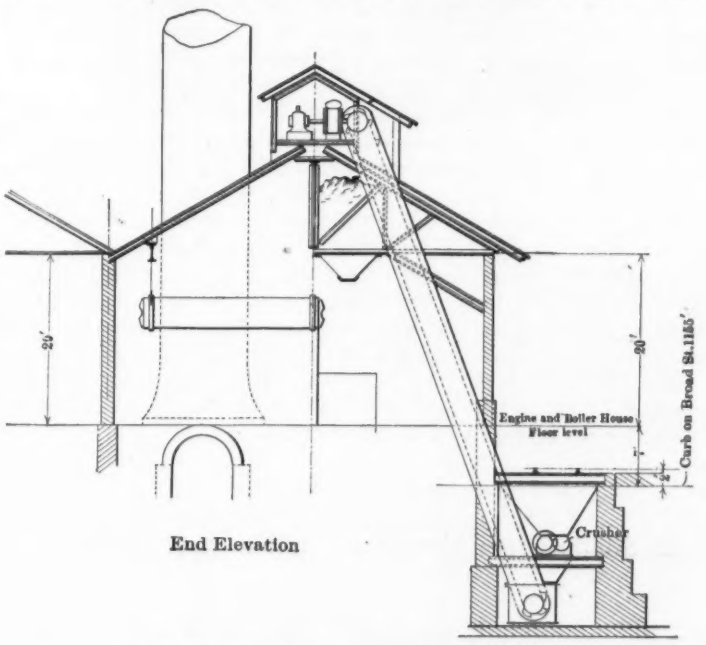
In accordance with the most modern practice, a moderate degree of superheat has been provided for by the use of Babcock & Wilcox coil superheaters located within the boiler setting and directly in the path of the gases. With this arrangement, a superheat of 60° to 90° at the turbine is obtained, the superheat increasing with the steam demand. In case of leaks or other troubles, the superheaters may be cut off by suitable valves and saturated steam supplied directly to the turbines.

Extreme simplicity characterizes the high-pressure piping system. Its dead weight is supported entirely by flexible iron hangers, and it is anchored at one point only—the center of the header. Long radius bends provide ample opportunity for expansion and contraction in all directions. No valves are used to section the header, which forms the lowest point of the steam system. Live steam drips are, therefore, tapped in at intervals to remove condensation when saturated steam is used. The drains are controlled by Bundy traps, which also drain the 5-in. Cochrane separators protecting each turbine. Extra heavy pipe fittings are used throughout, with corrugated copper gaskets, further sealed by thin sheet rubber. All live steam piping is covered with 85 per cent. magnesia of about 1½ in. thickness.

No auxiliary steam main is provided, all auxiliaries being driven either from the main line or from a 4-in. extension thereto. Feed water and air pumps operate under full boiler pressure, but the exciter uses steam at 80 pounds pressure, secured by a Foster reducing valve.

All boilers are fed by a duplicate set of 12-in. x 7-in. x 16-in. Epping & Carpenter duplex steam pumps of the outside-packed plunger type, taking their suction from a Cochrane open heater, which receives the exhaust steam from all auxiliaries. A 4-in. blow-off main connecting with each mud drum through a 2½-in. angle valve discharges into a 30-in. standpipe anchored to a concrete base. This is designed to act as muffler and condenser. Draft is supplied by a steel stack 10½ ft. in diameter and 200 ft. in height, with a flare base 14 ft. in diameter. It is anchored to a massive concrete foundation by means of gusset plates riveted to the shell. The stack is lined to the top. As before noted, it is of sufficient size for twice the present boiler capacity. A single stack was used in order to obtain increased draft and to carry the products of combustion to a sufficient height.

The arrangement of the coal-handling system is shown in outline in the accompanying section, Fig. 8. The coal, usually run of mine,



End Elevation

FIG. 8.—MOTOR-DRIVEN COAL CONVEYORS.

is first crushed and then elevated to a horizontal scraper conveyor, which extends over the bins through their full length. Slides at frequent intervals secure proper distribution of the coal in the bins. This apparatus was built by the Link-Belt Engineering Company. It is driven by three-phase Westinghouse constant-speed induction motors, with proper speed reduction. A 20-hp motor on the boiler room floor operates the crusher, a 10-hp motor located in the monitor, the elevator, and another 10-hp motor, the conveyor. With this equipment 30 tons of run-of-mine coal may be crushed and stored per hour. As the bins have a capacity of 200 tons, ample storage capacity is available for several days' stoppage of coal supply.

All generators, exciters and distributing circuits, also the motor-driven auxiliaries in the station, are primarily controlled by a 12-panel blue Vermont marble switchboard, shown in Fig. 5, which was built and installed, together with all other electrical apparatus, by the Westinghouse Electric & Manufacturing Company. The switchboard is set a distance of 6 ft. from the wall, giving ample room for working in the rear without danger. Its essential features are the use of round-dial, long-scale instruments, duplicate four-wire buses and four-pole, double-throw oil switches, those on the distributing panels having circuit-breaker attachment. Three ammeters are employed, with series transformers, in the three phases

of each circuit. Polyphase recording wattmeters record the output of the station, exclusive of motor-driven auxiliaries, and static ground detectors indicate the condition of the lines. The double bus permits the shifting of connections in case repairs are being made.

One panel is devoted primarily to single-phase circuits; the other to arc circuits. On the former, the shifting of feeder connections, to properly balance the load, is accomplished with insulated plugs, a special interlocking device preventing the short-circuiting of the phases by insertion of the plug into the wrong socket. This panel accommodates three single-phase circuits or two three-phase circuits. The arc panel is also equipped with plug sockets accommodating six single-phase circuits. Both have three ammeters for indicating the balance, and oil circuit-breakers for primary control. At present the alternating-current arc system is supplied by a 50-light General Electric constant-current transformer. Alternating-current, series enclosed lamps are used, running on about 7.5 amp.*

All outgoing feeders are protected by 40-amp. choke coils, one in each lead, with two 1,100-volt Westinghouse lightning arresters in series to ground. These feeders, after leaving the building, are carried on latticed steel towers along Broad Street to the junction with the main line.

Very complete records of all the important points relating to the generation and distribution of steam and electricity and of station cost and up-keep are maintained. In addition to the usual voltmeter and wattmeter readings for generators, exciters and feeders, Bristol gauges are employed for recording the changes in steam pressure, vacuum and bus voltage. Temperature readings are taken of (*a*) the steam at turbine throttles, (*b*) feed water at boilers, (*c*) incoming and outgoing condenser water, and (*d*) the temperature of air delivered to the dry air pumps. The recording meters are checked at intervals, and the charts furnish a valuable record of the character of service rendered by the plant.

It is a rather remarkable fact that the regular operating force during the night or load run consists of only three men, an engineer and a fireman, with one assistant. During the day or "stand-by" run, one man attends to the plant, making such repairs as are necessary. With the entire plant in service, the force will probably be increased to four night men. This, for a 2,000-hp plant, furnishes a striking illustration of one of the many economies of modern station apparatus and serves to emphasize the fact that in the substitution of machine power for manual labor not only is the operating efficiency improved, but the running expenses are materially lowered.

The Citizens' Light, Heat & Power Company is controlled and operated by local capital. The two plants of the Citizens' Company are under the management of Mr. J. W. Reeves.

Southeastern Kansas Telephone Association.

The Southeastern Kansas Telephone Association held a very interesting and important meeting at Galena on August 15. The principal object of the meeting was to discuss plans to put the independent toll line system in the eight counties in that part of the State and the northeastern part of the Indian Territory in shape to connect with the Kinloch Long-Distance Telephone Company, at Joplin, Mo., and Pittsburg, Kan. Plans for better and more extended farm telephone service were also discussed.

The territory covered by this association includes Chautauqua, Elk, Wilson, Montgomery, Neosho, Labette, Crawford and Cherokee Counties in Kansas and the Indian Territory lying north and east of the Arkansas River, and at the meeting on the above date the companies occupying this territory agreed to parallel their existing circuits with a sufficient number of No. 10 copper metallic circuits to enable them to connect with the Kinloch Long-Distance Company and give service to St. Louis and the east and Kansas City and the north. They also decided to establish a clearing house for the purpose of establishing uniform rates and adopting a system for handling the business interchanged among themselves as well as business to points outside this district.

The plans, when completed, will give the Galena-Joplin lead and zinc district, the coal district and the gas and oil district first-class independent toll service.

*About 350 direct-current enclosed arcs are supplied from the Vine Street plant.

The German Electrical Exhibits at the World's Fair.—I.

BY FRANZ WELZ.

IN viewing the exhibits of Germany at the St. Louis Exposition, as far as electricity is concerned, it must be borne in mind that for several reasons a large part of the products of the great electrical firms of Germany was naturally excluded from being exhibited at St. Louis. On the one hand the large-sized electrical machinery was kept away from St. Louis on account of the great expense and difficulty in transporting such heavy pieces of machinery so long a distance over land and sea; on the other hand, the question of the impossibility of selling electrical goods of German manufacture in this country had very much to do with the lack of the large type of German electrical machines at the Exposition; and the fact that Germany has no market is certainly the main reason why the smaller standard electrical machines and apparatus of German make are hardly represented at St. Louis.

The German electrical exhibits are, therefore, restricted to a carefully chosen selection of the latest types of electrical apparatus and instruments for scientific and practical use, covering the whole field of the study and application of electricity, and some of the prominent pioneer work of recent date of German engineers is shown and carefully illustrated by photographs, pictures, detail drawings, curves and diagrams. The number of exhibitors amounts to about sixty, comprising the most noted men and firms. The electrical exhibits have been collected under the direction of the German Ministry

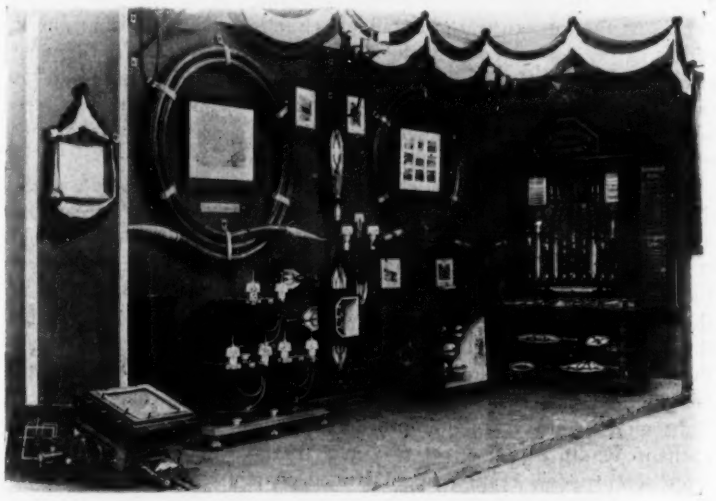


FIG. I.—EXHIBIT OF THE LAND UND SEEKABELWERKEN, KOELN.

for Schools and Education, with the assistance of the German Society for Optics and Mechanics, and the organization of the section for Scientific Instruments was in the hands of Prof. Dr. Lindeck, Berlin, whereas the electrochemical section was organized under the supervision of Prof. Dr. Harries, Charlottenburg, and Prof. Dr. Nernst, of Göttingen. The gentlemen in charge of the exhibits in St. Louis are Dr. H. A. Kruess, Dr. Zwingenberger and Mr. A. Wirth. In selecting the exhibits the greatest importance was laid on the condition that all apparatus and instruments should be of the very latest type and of special electrical and scientific value. In order to avoid a repetition of the German electrical exposition at Chicago, in 1893, it was not deemed fit to have any historical features at the display at St. Louis, and there is even no attempt made to demonstrate systematically by means of the exhibits the progress in the electrical science in Germany within the past ten years.

Following the grouping of the "Official Classification," we find that Germany has sent to St. Louis no generators, alternators, motors or transformers of huge size or of new constructional features, and the German practice of machine construction and building of big electric central stations is merely illustrated by a collection of pictures, drawings and maps, of which those of the "Allgemeine Elektrizitäts Gesellschaft, Berlin," representing their Berlin central stations, are the most interesting. The firm of Siemens & Halske, of Berlin, has on exhibition several types of its current transformers for potentials up to 30,000 volts. This is the only German transformer exhibit at the Exposition in the field of electric transportation, the "Studiengesellschaft für elektrische Schnellbahnen, Berlin," gives testimony of the splendid work done by its engineers in a collection of pictures of the electric high-speed railway equip-

ment, Berlin-Zossen, together with an exact report of the tests and the results obtained. The "Langen" monorail suspended electric railway system, as applied between Barmen and Elberfeld, and projected for the city railways of Berlin, Hamburg and London, is also represented by twenty fine pictures and detail drawings bringing forth very strikingly the main features of this new system. As to equipments for building electric street car lines, we find in the exhibit of Siemens & Halske, Berlin, an apparatus for measuring the resistance of rail joints. This apparatus does not allow a direct reading of the resistance in ohms, but gives a comparison of the joint resistance with the resistance of a continuous piece of rail, from which the true resistance can be obtained by a simple calculation. In the line of cables for electric light and power transmission we find a very attractive and interesting exhibit of the "Land und Seekabelwerke," of Koeln-Nippes, as illustrated in Fig. 1. One of the most interesting pieces of this exhibit is a cable ring for an actual service pressure of 50,000 volts. The cable, designed for three-phase service, is of 10 sq. mm. section per conductor. The distance between the conductors is not more than one and one-half inches. Instead of using rubber for insulation a special insulating band, impregnated with a mass of the highest insulating qualities, surrounds the wires. The three conductors are twisted in certain intervals and all three wires are surrounded by a three-quarter-inch layer of the same insulating material, then come two covers of lead, protected by an iron band armor and finally covered with impregnated rope. The outside diameter of the cable is three and one-half inches. At the Düsseldorf Exposition, in 1902, there was half a mile of this type of cable installed for the light and power transmission and this was in actual service under the pressure of 50,000 volts during the whole

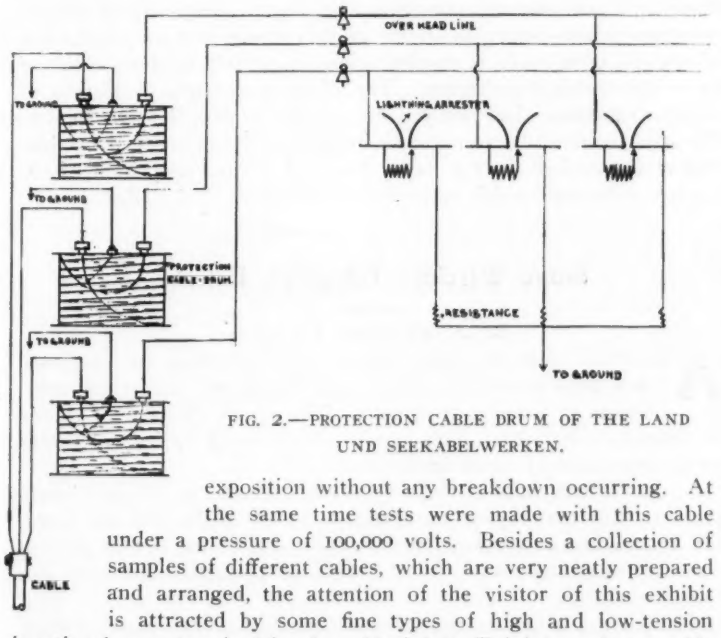


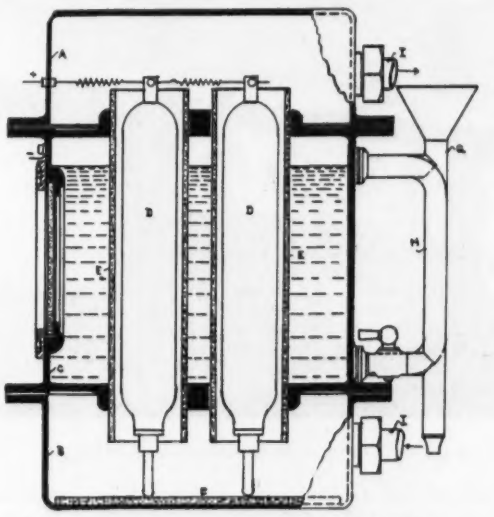
FIG. 2.—PROTECTION CABLE DRUM OF THE LAND UND SEEKABELWERKEN.

exposition without any breakdown occurring. At the same time tests were made with this cable under a pressure of 100,000 volts. Besides a collection of samples of different cables, which are very neatly prepared and arranged, the attention of the visitor of this exhibit is attracted by some fine types of high and low-tension junction boxes, terminal heads, cable joints, T joints and one cable branch box with switch. The latter apparatus is typical for cable work as it is done in Germany and everybody concerned in this matter must admit that all these appliances have been worked out with great thoroughness and technical skill, guaranteeing the absolute safety of the cable line. In this connection it must be remembered that overhead lines are out of the question in many cases, so that cables have to be used more extensively even for long-distance transmission. We see that it was to a very large part the necessity for cables which has caused the high development in the art of their manufacture. Another new feature in the high-tension field is shown by this company in its so-called "protection cable drums," which are inserted, as shown in the diagram, Fig. 2, at the point where the cable line goes over to an overhead line. The object of the arrangement is to protect the cable from static discharges taking place in the overhead line.

In the "Electrochemistry" group Germany is very creditably represented by a great number of the latest and finest laboratory apparatus as well as apparatus for technical use, and there are on exhibit a large collection of samples of chemicals derived from electrolytic processes. One of the most interesting pieces of apparatus is a modern Siemens & Halske ozonizer, as it has been used by Prof. Dr. C. Harries, of the First Chemical Institute of the Berlin University, for the oxidation of different kinds of organic substances. The ozone in this apparatus is produced by electrical high-tension discharges between two concentric cylindrical surfaces through which air is circulated. Figs. 3 and 4 illustrate the apparatus as it is used for the purifying of water. The apparatus consists of a cast-iron tank closed tightly on the upper and lower end by a case-shaped

FIG. 3.—SIEMENS & HALSKE OZONIZER.

lid. In this case are mounted ten glass tubes placed into the upper and lower lids, so that the middle chamber is made water-tight. In service, the tank is filled with water, which partially serves for cooling purposes and partially as conductor for the electrical current. In the interior of the glass cylinders are mounted the so-called inner poles in such a way that an equal distance is kept between the same and the glass cylinders. These inner poles are joined together by



A—Upper Lid.
B—Lower Lid.
C—Tank.
D—Inner Pole.
E—Glass Cylinder.
F—Insulating Plate.
G—Water Inlet.
H—Water Outlet.
I—Ozone Pipe.

FIG. 4.—OZONE APPARATUS OF SIEMENS & HALSKE.

an electric conductor and connected to one pole of the high-tension transformer; the other pole of the same is connected to the tank, closing the circuit through the water to the glass cylinders. The 50-cycle transformer, which is connected on the primary side to 120 volts and steps the voltage up to 10,000 volts, is of special construction, the primary side being in circuit with a rotating interrupter of the commutator type, with eleven segments and running at 800 r.p.m., being fed through a 110-volt, direct-current circuit. If the

transformer is excited at a certain voltage, so-called quiet electric discharges take place between the glass cylinders and the inner poles and a violet light effect without visible sparks appears in the air space. The air to be ozonized after being submitted to a drying process, is brought into the apparatus by a motor-driven blower. The ozone developed by this process accumulates in the upper lid of the tank and is conducted from there through pipes to the sterilization tower, where it is forced through the water to be treated. The result of the application of ozone to the water is that practically all bacteria and putrefying substances injurious to health are killed and the water leaves the apparatus entirely colorless, meeting all requirements of hygiene.

After having built a small ozone water works for testing purposes, the Siemens & Halske Company installed this system of water purifying on a large scale at the cities of Wiesbaden-Schierstein and Paderborn and the works there have proven that this system gives excellent results for any size of installation and in any respect as to its technical part and as to its chemical and bacteriological qualities.

This type of ozone apparatus has also found an extensive use for bleaching of yarn. The process is as follows: The yarn, after having been submitted to a short treatment with chloride of lime, is hung up in a room where it is treated with the ozone. The advantage of this process is that the time for the bleaching can be shortened very considerably.

Among the other exhibits in this section the following may be mentioned as interesting: Four showcases with a collection of apparatus of Prof. Dr. Ostwald, of Leipzig, of which a complete chemograph, an apparatus for the determination of the conductivity of different electrolyses and an apparatus for measuring e.m.f. by the compensation method, made according to the indications of this prominent scientist is of special interest. Another showcase contains two dielectric apparati with a Tesla transformer made by W. Schmidt, Giessen, in conformity with the instructions of Prof. Dr. Drude, of the University of Giessen. A very impressive exhibit, distinguished by the neatness of its appearance and the skillfulness of its arrangement, is an "electrochemical working place," being a true copy of the equipment at the Electrochemical Institute at Göttingen, which is under the direction of the inventor of the much-admired Nernst lamp. This working table is illustrated by Fig. 5.

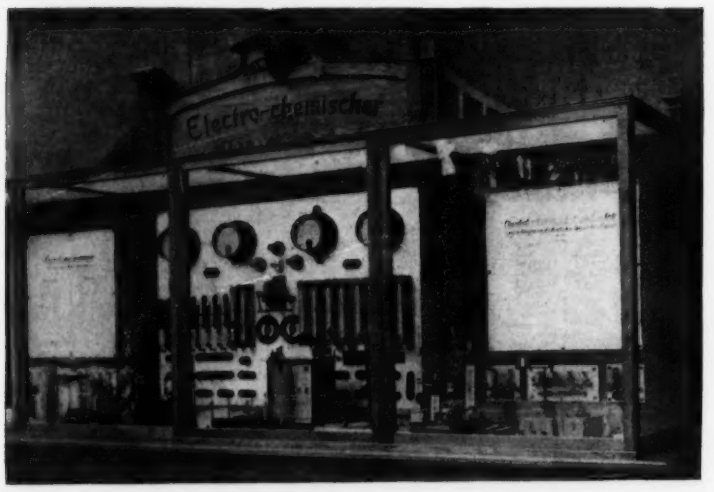


FIG. 5.—LABORATORY OF ELECTROCHEMICAL INSTITUTE, GÖTTINGEN.

The back wall of this working place is formed by a switchboard constructed by the firm of Gebr. Ruhstrat, of Göttingen, with ammeters and voltmeters, a galvanoscope (built as zero instrument), a series of double resistance for 0.2 amp., 3,000 ohms; 1.5 amp., 175 ohms, and one for ⅓ amp., 220 ohms. On the table are a number of instruments as they are used in modern electrochemical laboratory work, of which may be mentioned a decade rheostat and a precision voltmeter, of Hartmann & Braun, Frankfurt; an apparatus made by W. Apel, Göttingen, according to instructions of Prof. Nernst for the determination of the dielectric constant; a mercury voltameter made after Danneel, and a collection of apparatus from R. Mittelbach, Göttingen. Of the last the following are especially interesting: An apparatus of Nernst for "concentration chains," an apparatus of Glaser for the determination of the decomposition voltage, etc.; an apparatus of Prof. Dr. Abegg, Breslau, for measuring directly the mobility of the ions; a large collection of Prof. Elbs, Giessen, comprising an apparatus for the electrochemical reduction of compounds of nitrogen in alkalic solutions; an apparatus for the electrochemical reduction of kentone and an apparatus for the electrochemical production of the tetrachloride of lead. Prof. Dr. Coehn, of Göttingen, shows on this working table some peculiar precipitates of carbon, and Prof. Dr. Ruff, Berlin, exhibits his apparatus for the electrolytic production of calcium.

In two special showcases are found two sets of apparati of Prof. Dr. A. Classen, of Aachen, for different quantitative electroanalyses employing current from an accumulator and the same apparatus for the use of 110-volt current from the mains. In three showcases are exhibited twenty-four pieces of apparatus of highest scientific value, as they were used by the late Dr. Lüpke, of Berlin. Among these is seen a device for the demonstration of the convertibility of chemical energy into electrical energy. Under the scientific instruments for use in electrochemistry are found a universal measuring bridge of Prof. F. Kohlrausch for direct reading of resistance in ohms and specially built for measuring resistance of electrolytes by means of alternating current, a telephone and a drum-measuring bridge of the same inventor. These two latter apparati are built by Hartmann & Braun, Frankfurt.

In order to give a full conception of the present standing of electrochemistry, its extensive application and great importance in modern life, we find, besides the above apparatus, an almost complete collection of samples of elements and compounds produced by electrochemical processes. In addition to the common metals precipitated by means of current there are found also the more rare metals, Cer, Didym, etc. The inorganic salts, as mostly used in technical chemistry, are fully represented. The organic preparations are interesting to the expert, inasmuch as they prove that the production of organic compounds is restricted almost entirely to those obtained by electrochemical reduction. The direct electrolytic oxidation of organic substances has not yet attained the same extensive application, and the difficulty seems to lie in the inability to arrest the oxidation at the desired limit in order to avoid the decomposition of the organic substance, which takes place if this limit is exceeded.

Stone Wireless Telegraph Patents.

BY A. FREDERICK COLLINS.

A BATCH of nearly forty patents, for apparatus and methods, has been issued to John Stone Stone for further improvements in wireless telegraphy. The specifications treat chiefly of resonant and co-resonant systems, with many varied references to arrangements of lesser importance.

As may be imagined by those who have followed Mr. Stone's work, there is little that represents invention as we understand the word, but the numerous combinations of open and closed circuit oscillators and resonators seem to be a kind of by-product of deep and logical reasoning.

The patents under consideration are numbered consecutively from 767,970 to 768,005, and it would, therefore, be quite impossible within the limits of this article to give more than a brief résume of the purposes set forth in those specifications deemed the most important.

Beginning with the first issue, there is information relating to an apparatus patent, and which has for its object the transmission and reception simultaneously of wireless telegraph signals. The theory upon which this phenomenon is based "depends upon the fact that if in a vertical conductor lying in a plane equidistant at all points from two other vertical conductors, there will be developed electrical oscillations which in the last-named aerials will be equal in amplitude and phase, and if the effects of these oscillations upon a receiving device be opposed to one another their resultant effect upon the receiving device will be nil."

The arrangement for the fullfilment of the above conditions is shown in Fig. 1, and consists of a combination embodying the principles of an induction balance and, according to the inventor, it has been shown that two vertical receiving wires will be incapable of receiving signals from any transmitting station in their equatorial plane, but will in general be capable of receiving signals from stations otherwise located.

Following these are several patents interesting in virtue of the fact that the idea of utilizing for an electric wave detector, a bolometer, an instrument heretofore chiefly employed for measuring minute

differences of temperature by changes in its electrical resistance. The bolometer in its present state of development is a marvelously sensitive instrument for the detection of exceedingly feeble radiation and will masure accurately to less than one ten-thousandth of a degree Fahrenheit.

In one of the paragraphs it is pointed out that the bolometer has been used for the measurement of dielectric constants and is espe-

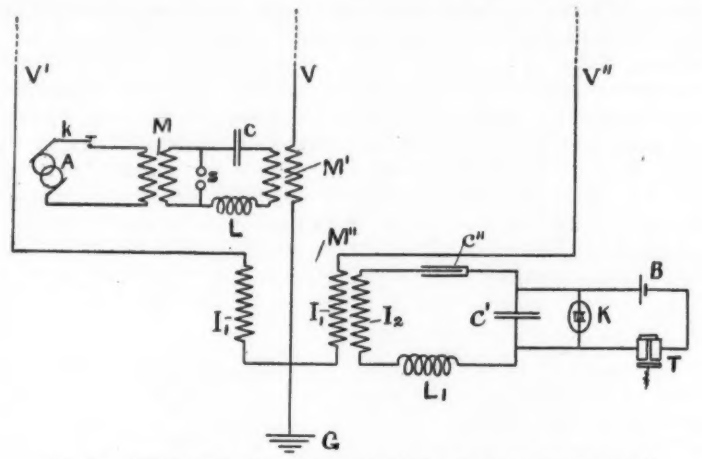


FIG. 1.—APPARATUS FOR SIMULTANEOUS WIRELESS TELEGRAPHY.

cially suitable for the detection of electric waves of lengths longer than those of light, i. e., Hertzian waves. To quote from the specifications, when the bolometer is used to detect electromagnetic radiations of wave lengths, great compared to those of radient heat, the electric waves cause a current to be set up in the bolometer wire.

The energy of the current oscillations is converted into heat in the wire of the instrument, raising its temperature, thereby increasing its resistance and unbalancing the bridge or induction balance, of which it forms a part. When the bolometer is used as an electric wave detector, the thermal time constant of the wire must be small compared with those heretofore used, so that it may indicate the impulse quickly and be restored for the succeeding impulse, hence, the wire is made small, so that its specific heat capacity is small.

Following this is a description of its use in combination with wireless telegraph circuits, all of which is interesting in view of the

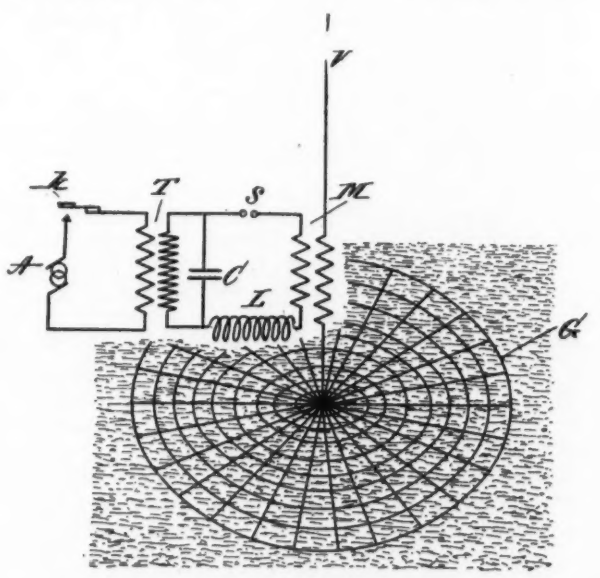


FIG. 2.—METHOD OF INCREASING THE EFFECTIVE RADIATION OF ELECTROMAGNETIC WAVES.

fact that both the Fessenden hot wire barretter and the bolometer serve to indicate the presence of electric oscillations through the minute variations of temperature in a wire of almost microscopic diameter.

In his method patents "of increasing the effective radiation of electromagnetic waves," Stone adduces additional information regarding the theory of sliding half waves, which he states were discovered by Blondel in 1898; the invention for producing the above noted increased radiation consists of "artificially increasing the natural conductivity of the earth or other media in the immediate vicinity of the base of the transmitting aerial wire and maintaining said surface in a constantly conducting state."

To successfully carry out this scheme in practice is an exceedingly simple matter, and it may prove of value where the radiator system is placed on land, especially if the soil immediately surrounding it is in a dry condition. This invention consists of a wire netting having a large mesh laid on the surface of the ground, so that it completely surrounds the aerial wire with which it is connected, and one of the conditions imposed by the designer is that the artifice has a radius at least equal to one-quarter of a wave length. The arrangement is shown in Fig. 2.

Among the batch of patents are a large number simply designated "space telegraphy," which relate chiefly to methods for obtaining selective signals by projected waves of predetermined frequency and of predetermined group or wave train frequency; others describe circuits for producing persistent trains of electric waves, and again some treat of means whereby waves of constant amplitude may be developed in an elevated conductor; all of these are of great value in the elucidation of resonance phenomena, but which seem as little likely to bring forth actual selective wireless telegraphy as those that have passed before based upon purely syntonic principles.

Of specific devices other than those cited above, adapted to sending and receiving apparatus for wireless telegraphy is the thermo-electric couple, which Stone shows how to use as a wave detector; an adjustable spark-gap in a vessel containing a gas under pressure greater than that of normal atmospheric pressure; a novel method of constructing towers and masts for the suspension of aerials "so that there shall be no mechanically continuous portion of the structure whose length shall be more than a small fraction of one-half the length of the waves to be radiated."

One of the simplest devices and one that may finally supplant the high aerial wire systems which now form such a vital factor in long-distance transmission is embodied in the specifications, No. 767,986, 767,988, 767,989 and 767,999. By referring to the diagram Fig. 3, it will be observed that *A* represents an alternator having a

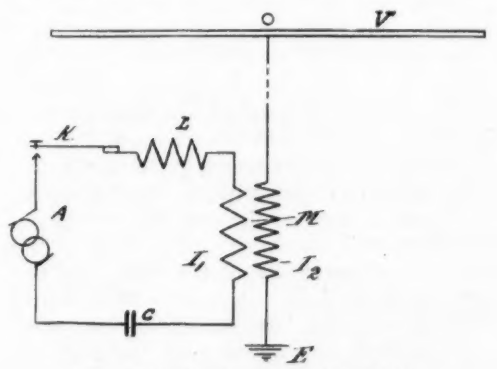


FIG. 3.—SUBSTITUTE FOR ANTENNA.

key, *K*, and the primary of the transformer, *M'*, in series. The secondary of the transformer forms a closed oscillating circuit through the condenser, *C*, the inductance, *L*, and the primary, I_1, of the oscillating-current transformer, *M*, of which I_2 represents the secondary coil.

The terminals of the latter are connected to the usual earth plate, *E*, and to a short aerial joined to the center of a large metallic plate, *V*, which may be of any form, although a circular form is preferred, but in any case the capacity must be parallel to the earth and "whose diameter and consequently whose periphery is preferably great compared to its distance from the ground." Then follows the theoretical considerations upon which this substitute for the lofty aerial is based, as well as claims covering the method of developing electric waves, consisting of forced oscillations in a conductor of large area placed parallel with the earth.

One of the features embodied in Stone's patent specifications and which every inventor might follow to his own profit, and the saving of time to others, is the inclusion of a bibliography in the text of subjects under consideration. For instance, in the matter of the sliding wave theory there is given: BLONDEL, *Comptes Rendus*, Nantes, August 11, 1898; BROCA, *Société Française de Physique*, Paris, May 5, 1899; TAYLOR, *Electrical Review*, London, May 12, 1899, and other authors and publications, so that it becomes an easy matter to determine the authorities for statements made and where their papers may be found, which is a most excellent practice.

Telegraphs and Telephones in Great Britain.

The issue of the Postmaster-General's report is the final installment of the annual batch of information regarding the work of telegraphs and telephones in Great Britain. Dealing with telegraphs, the current report notes a slight decrease in the number of telegrams during the year under review. The total number of telegrams was 89,997,000, as compared with 92,471,000 for the previous year, a decrease of 2.7 per cent. The report says that this decrease is, no doubt, partly due to trade and especially Stock Exchange depression, "but probably the principal cause is the growth of the telephone system. This is to be expected when it is remembered that a single telephone conversation often takes the place of two or more telegrams." This view of the effect of the telephone on telegraph service is contrary to the general idea that the telephone acts to a certain extent as a feeder of the telegraph system. In Great Britain, with the exception of one year, 1900-01, when there was a decrease of .9 per cent., the number of telegrams has shown a steady increase each year. The total revenue from telegrams during the year under review was £2,755,732, say $13,750,000, the average value per message being between 14 and 15 cents. There are now in the United Kingdom 9,976 telegraph offices at post-offices, and 2,357 at railway stations and other public places.

The report makes note of the intercommunicating system established in London last year, in which a switchboard of a similar character to a multiple telephone switchboard is used for directly connecting together the various offices in the London area. This cuts out a re-transmission at the central office and much improves the London telegraph service. Between 3,000 and 4,000 telegrams pass daily between the offices connected in this manner. This figure is of interest when it is considered that the daily telephone traffic of London must be about 120 times as much.

An interesting note is given descriptive of the progress on the underground telegraph line between London and the north. This line was commenced some years ago with the object of providing a main line of telegraphic communication through the country which should be proof against interruption by storms. The line is now complete as far as Carlisle, 300 miles from London. A spur line has been laid from the main route to Leeds, and it is expected to extend the main line to Glasgow in the near future, and also to lay an underground line between Glasgow and Edinburgh.

The report makes note of the magnetic storm of October 31, 1903. This storm set up earth currents of considerable extent. The disturbances continued throughout the day and seriously affected telegraphic communication in all parts of the country. Devices were applied for diminishing the effects of the storm and communication was kept open, but some delays occurred in disposing of the traffic, which, as usual on Saturdays, was very heavy and was increased by press messages sent in connection with three political speeches. Storms of this nature occur in England only at long intervals, and as a rule their effect is not widespread. The last occasion on which interruption of any magnitude occurred from this cause was shortly after the acquisition of the telegraphs by the State in 1870.

Regarding wayleaves, a continual difficulty in Great Britain with the owners of telegraph and telephone wires, the Postmaster-General states that he observes with much concern a growing tendency on the part of local authorities to attach onerous conditions to the consents granted by them for the erection of overhead lines. Many of these are inconsistent with the statutory right of the Postmaster-General to use the public highway for his telegraphs, and in three instances during the past year it has been necessary to appeal to the courts.

As regards any progress in the science of telegraphy, the report is completely silent. It is common knowledge that for some years past the post-office has been experimenting with modern high-speed printing telegraph systems, but so far it has not apparently been able to bring itself to adopt any improvement of this sort.

A short account is given of the work of the International Telegraph Conference of last year, and note is made of the success of the British delegates in opposing the compulsory adoption of the proposed "Official Vocabulary," which had been prepared by the International Telegraph Bureau for code telegrams. After long discussion the conference finally decided that the use of words drawn from the vocabulary should not be made compulsory in code telegrams, and the field of selection was widened by the admission of artificial words pronounceable in accordance with the usage of any one of the eight languages from which ordinary code words may be selected.

The report makes note of the International Conference on Wireless Telegraphy held in Berlin last year, but states that the recommendations of the conference were not approved by the British delegates. These recommendations were that shore signal stations should be bound to exchange messages with all ships, regardless of the system of wireless telegraphy employed by the ships, and that the rate of charge for each shore station and for each ship should be subjected to Government control. Since the Postmaster-General's report was put in press a Wireless Telegraphy Act has been passed which gives the post-office absolute control of wireless telegraphy in Great Britain and on British ships. This act was brought in at the fag end of the session, and in spite of some protest, was rushed through all its stages with practically no discussion. It is limited to two years, but it establishes a Government monopoly which it is very unlikely that the officials concerned will ever relinquish.

TELEPHONY.

The report is silent regarding the proposed Government purchase of all the telephone systems of the country, which was announced by the Postmaster-General in the House of Commons in March last. The negotiations which the Postmaster-General stated had been begun have apparently not come to any definite conclusion, and no official announcement will probably be made as to the course they may have taken until Parliament meets again next year. It may reasonably be concluded, therefore, that the proposed Government monopoly in telephones is not likely to be established just at present.

As regards post-office work in telephones, it is shown that the long-distance system now contains 102,000 miles of wire and handled, last year, 13,468,000 calls, giving a revenue of £325,525. The provincial telephone exchanges of the post-office serve altogether 6,874 telephones, and the post-office London system 15,632 telephones. The total capital cost of the London system has been £1,514,300, and it is estimated that the actual cost of each subscriber's line, exclusive of spare plant, is £41 10s., say $205. At the present time, owing to large capital expenditure and the low rates in force, the system is being run at a loss of over $250,000 a year.

As far as financial results are concerned, the post-office makes a sorry showing with all its telegraph and telephone business. The total revenue from all sources is $18,600,000 and the total expenditure $23,500,000, giving a total deficit of $4,900,000. In the total expenditure there is included a certain amount of capital expenditure, and if this is deducted and allowance made for the interest on the original capital cost of the telegraph, it appears that the actual loss on the working of the post-office telegrams and telephones is about $3,000,000.

According to the half-yearly report of the National Telephone Company, the total number of telephones now connected to the systems of that company is just short of 300,000. During the past half year the increase was a little under 20,000 stations. The total capital of the company is $52,000,000, and the annual revenue is now at the rate of nearly $9,000,000. The working expenses are 62 per cent. of the income after deducting post-office royalties, which are at the rate of 10 per cent. on the gross receipts from exchange business. During the year ended December 31 last, the company paid the post-office nearly $850,000 in royalties.

In municipal telephony there has been little new work done in Great Britain during the past year. The town of Hull is constructing a small system for 2,000 subscribers, which is about to begin working. The Glasgow system gained 2,283 stations during the year, a considerable falling off from the previous year. The total number of stations in the Glasgow municipal system is now 11,400 and the total capital cost has been $1,600,000. The National Company's system in Glasgow still preserves a long lead over that of the municipality, having over 16,000 stations to the 11,400 of the municipal system. Including the three other small municipal systems at work, the total number of municipal telephones working in Great Britain is about 15,000. The total number of post-office telephones is 22,400, making the total telephones in Great Britain—company, post-office and municipal—337,000. The total capital cost of all the telephone systems of the country, including the long-distance wires, is approximately $75,000,000.

American Electrical Jurors at St. Louis.

Prof. W. E. Goldsborough, of the Department of Electricity, at St. Louis, has issued the following list of American jurors in the Electricity Section of the International Jury of Awards at the St. Louis Exposition:

Group 67, Machines for Generating and Using Electricity.—W. V. N. Powelson, assistant general manager Union Electric Light & Power Company, St. Louis. H. B. Smith, professor electrical engineering, Worcester Polytechnic Institute, Worcester, Mass. M. H. Gerry, chief engineer of Missouri River Power Company, long-distance transmission plant, Canyon Ferry, Mont. O. T. Crosby, consulting electrical engineer, 43-49 Exchange Place, New York City. C. W. Wason, president C. P. & E. Electric Railway, Cleveland, Ohio. J. P. Jackson, professor electrical engineering, Pennsylvania State College, State College, Pa. G. F. Baum, professor electrical engineering, Stanford University, Cal. P. O. Keilholtz, general manager United Electric Light & Power Company, Baltimore, Md. E. P. Roberts, consulting electrical engineer, 602 Electric Building, Cleveland, Ohio. (Formerly professor of electrical engineering, Cornell University.) R. B. Owens, professor electrical engineering, McGill University, Montreal, Canada. G. F. Sever, professor electrical engineering, Columbia University, New York City. J. W. Esterline, assistant professor electrical engineering, Purdue University, Lafayete, Ind. H. H. Norris, assistant professor electrical engineering, Cornell University, Ithaca, N. Y.

Group 68, Electrochemistry.—Carl Hering, consulting electrical engineer, 929 Chestnut Street, Philadelphia, Pa. Member of International Juries of Award of several expositions in Europe, including Paris, 1900. Dr. Samuel Sheldon, professor electrical engineering, Brooklyn Polytechnic Institute, Brooklyn, N. Y. Vice-president A. I. E. E. C. F. Burgess, professor electrical engineering, University of Wisconsin, Madison, Wis.

Group 69, Electric Lighting.—F. E. Drake, president Lanyon Zinc Company, St. Louis. E. L. Nichols, professor physics, Cornell University, Ithaca, N. Y. Paul Anderson, professor electrical and mechanical engineering, Kentucky State College, Lexington, Ky. G. D. Shepardson, professor electrical engineering, University of Minnesota, Minneapolis, Minn. C. A. Adams, professor electrical engineering, Harvard University, Cambridge, Mass. Henry Floy, consulting engineer, 220 Broadway, New York. B. V. Swenson, assistant professor electrical engineering, University of Wisconsin, Madison, Wis. Warren E. Weinsheimer, 139 Adams Street, Chicago, Ill.

Group 70, Telephony and Telegraphy.—A. E. Kennelly, professor electrical engineering, Harvard University, Cambridge, Mass. W. J. Hammer, consulting electrical engineer, 26 Cortlandt Street, New York City. F. B. Herzog, 51 West Twenty-fourth Street, New York City. J. C. Kelsey, professor telephone engineering, Purdue University, Lafayette, Ind. A. S. Langsdorf, professor electrical engineering, Washington University, St. Louis.

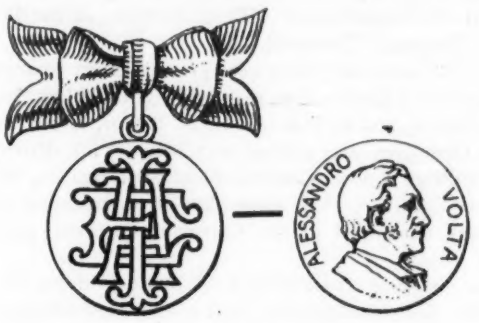
Group 71, Various Applications of Electricity.—C. R. Cross, Thayer professor physics, Massachusetts Institute of Technology, Boston, Mass. Dr. William J. Morton, 19 East Twenty-eighth Street, New York City. E. B. Rosa, physicist Bureau of Standards, Washington, D. C. Lieut.-Col. Samuel Reber, United States Army, Washington, D. C. F. A. Wolff, professor physics and electrical engineering, Columbian University, Washington, D. C. Frederick Bedell, assistant professor physics, Cornell University, Ithaca, N. Y. Captain M. C. Buckey, War Department, Washington, D. C. Dr. K. E. Guthe, physicist, Bureau of Standards, Washington, D. C.

International Electrical Congress Badges.

The accompanying illustrations represent as nearly as may be, in the absence of color, the badge of the International Electrical Congress and the several special badges which have been designed to commemorate the visit to our shores of British and Italian electrical engineers.

The Congress badge is about the size of a cent, irregular in outline, and is struck in bronze finished to a dull color. The subject is a reproduction of the main feature of the seal of the St. Louis World's Fair, surrounded by the inscription, "International Electrical Congress of St. Louis, 1904." Attached to the medal will be a ribbon carrying a number corresponding to that opposite the name of the wearer, in the list of members in attendance to be printed daily in the *Bulletin* of the Congress The ribbons will be of seven colors to distinguish the various classes of members, as follows: General members, white; general officers, orange; section officers, pink; chamber of delegates, blue; delegates of co-operating associations and societies, Nile green; advisory committee, lavender; local committees, lemon yellow.

The badge of the British Institution of Electrical Engineers is, as will be seen by the illustration (the illustrations all being full size), considerably larger than the Congress badge, and in the absence

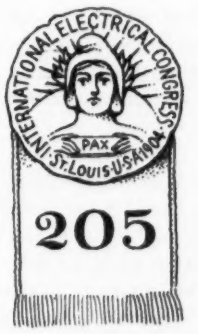


ITALIAN.

of color but a faint idea of its handsome appearance can be conveyed. The outer rim and the enclosure of the monogram of the Institution are in gilt. The name of the Institute is in gilt letters on white enamel and the inscription, "American Meeting, 1904," is in gilt letters on light brown enamel. The background of the central monogram is in dark blue. As may be surmised from the above description, the badge is extremely successful in design and in color.

The badge of the Associazione Elettrotecnica Italiana is a very artistic and striking piece of work and consists of a disc of silver

BRITISH.



CONGRESS.

A. I. E. E. TOUR.

about the size of a quarter dollar. On the face are the initials of the society in relief, enameled in red, white and green for the national colors of Italy. On the back is a portrait in relief of Volta—an excellent piece of die work. The badge is carried by a button to fasten into the coat lapel, and it is tied with silk ribbon in the Italian tri-color.

The badge of the American Institute of Electrical Engineers, which will be presented to those taking part in the circular Congress tour, embodies a neat idea. As will be seen, it consists of the regular Institute badge for full members, enclosed within a ring, and bears the inscription, "Circular Tour," on a ground of blue enamel.

Independent Telephony in Ohio.

In accordance with the plans laid down at the recent meeting in Columbus, Ohio, of the Ohio Independent Telephone Association, district meetings were held at Cleveland on August 16, at Toledo on August 17, and at Lima on August 18. The Cleveland meeting was attended by the managers of 65 independent companies in the district, which comprises the Counties of Ashtabula, Cuyahoga, Lorain, Erie, Huron, Medina, Lake, Geauga and Trumbull. Verbal reports were made by all the managers present. In addition to the representatives of the district, there were present President Beam, of the State Association; W. F. Laubach, of Akron; J. B. Rhodes, of Zanesville; G. H. Methien, of Lima; R. E. Hamlin, of Toledo; D. E.

Sapp, of Mt. Vernon, and Ralph Reaman, treasurer of the State Association. President Beam made a short address, in which he complimented the district on the showing it made and outlined some of the plans of the association.

An executive committee consisting of one representative from each county in the district was then chosen with Vice-President Hoge at its head. The committee is made up as follows: L. Hageman, of Lorain; B. Hendrickson, of Medina; W. B. Woodbury, of Cleveland; S. R. Newberry, of Ashtabula; Harry Grall, of Lake County; W. Hyde, of Trumbull County; Dr. Pomeroy, Geauga County; E. L. Coen, of Erie County, and Dr. Calhoun, of Huron County. The secretary of the organization is L. C. Norton, of the United States Telephone Company, Cleveland.

At the Toledo meeting there were present about 50 superintendents and managers. Addresses were made by President Beam, of the State Association, and by others. H. P. Taylor, of the Toledo Home Telephone Company, was elected secretary. This district comprises Williams, Fulton, Lucas, Ottawa, Sandusky, Seneca, Wood, Henry and Defiance Counties. The same plan of organization and proposed work as was developed at the Cleveland meeting was adopted at Toledo.

The Lima meeting was attended by about 50 delegates. President Beam, of the State Association, was also in attendance. The meeting was presided over by George H. Methien, vice-president of the district. Mr. J. B. Hoge, secretary of the United States Telephone Company, of Cleveland, outlined the action that should be taken to obtain the results aimed at by the State organization. Mr. David Clark, of St. Marys, was elected secretary. The district comprises Allen, Auglaize, Hardin, Hancock, Wyandot, Marion, Paulding, Van Wert, Putnam and Mercer Counties.

CURRENT NEWS AND NOTES.

ELECTRICAL ASSOCIATION OF NORTH DAKOTA.—This association, which was organized early in the year, will hold its next meeting at Fargo during the first week of October. Mr. S. J. Fuller, of Larimore, N. D., is secretary of the association.

ELECTRIC LIGHT ON BOSTON EXPRESS TRAINS.—It is stated that the New York, New Haven & Hartford Railroad Company will electrically light its express trains between New York and Boston. Six trains have already been ordered to be equipped with the system. The company has announced plans for extensive improvements to its general system, which will involve the outlay of several millions of dollars.

WIRELESS TELEGRAPHY ON THE PACIFIC COAST.—The Pacific Coast Steamship Company has decided to install wireless telegraphy apparatus on the steamers *Queen, Amatilla* and *City of Puebla,* plying between San Francisco and the cities on Puget Sound. As soon as the wireless station on Tatoosh Island, near the entrance to Puget Sound, is ready for operation the telegraph plants of the Pacific Coast Steamship Company's vessels will be installed so as to give early news of their movements.

CONSTANT-CURRENT SERIES MOTOR.—In the operation of a series-wound motor on a constant direct-current circuit, it is found that the motor has no definite speed for a given load. Such a motor exerts approximately constant torque at all speeds, due to the constant value of both the armature current and the field magnetism. In order to vary the field of the motor with relation to the speed of the armature, Maurice Leblanc, according to two patents issued August 23, mounts a dynamo upon the shaft of the motor and electrically connects it to the motor in such a manner that at slow speeds the dynamo furnishes practically no current to the motor field, but as the dynamo and motor reach a predetermined speed the dynamo quite suddenly furnishes sufficient opposing current to the motor field circuits as practically to neutralize the field strength of the motor. By the use of a properly designed exciting dynamo the set may be caused to operate quite similarly to a direct-current, shunt motor.

NOTES ON ELECTRIC SERVICE.—The United Electric Light & Power Company, Baltimore, is using a good educational advertising scheme. To each customer is sent once a month an illustrated bulletin called "Notes on Electric Service," which contains views of special local interest showing various electrical installations, and embodies numerous suggestions as to the convenience and economy of electric service. Free incandescent lamp renewals are now supplied at the expense of the company, and the customers are urged to return all lamps when they become dim or blackened. A charge of ten cents per kilowatt-hour is made for general lighting and power service. On the first night of the recent big fire, and while it was fiercely raging, all of the city lamps outside of the burned district were lighted within a few minutes after sundown. These facts serve as good advertising material for a wide-awake company. Mr. Douglass Burnett, a rising young electrical engineer, formerly with the New York Edison Company, is manager of the Baltimore system.

RAILWAY SIGNAL SYSTEM.—To Mr. J. H. Francisco, of Rutland, Vt., has been granted a patent for a block signal system which has been devised to insure absolute immunity from danger of collisions. To obtain the result desired, the tracks are divided into blocks about 1,500 ft. long, each block being provided with three circuits, one primary and two secondary, through a set of six circuit contact rails and occupying a space about 20 in. in width. Through these contact rails the signal-operating current is carried, one set of rails forming a continuous feeder circuit, and the other two sets being broken by insulation at the block ends. The four rails forming the two insulated block sections are connected so as to act only upon the closure of the circuits by the engagement of the contact wheels of the corresponding circuits of the locomotive equipment in the train moving through the block. A red danger lamp, denoting stoppage, is placed at the end of each block and a green caution lamp is located about 1,000 ft. in the rear of the red lamp. In multiple circuit with these stationary lamps are connected similarly colored lamps in the locomotive cab. A white pilot lamp burning continuously in the cab serves to indicate the operating condition of the supply system. When an engine enters a block, contact shoes strike the signal lamp rails and the rails of the supply circuit and the pilot lamp is lighted. Any other locomotive passing into the same block causes the danger lamp to give forth red light in the face of the engineer. An automatic switch circuit-closer furnishes a safeguard against collisions caused by misplaced switches, the act of opening of the main track transmitting a signal to the rear and into the cab of any locomotive coming from such direction, the operation being the same as though produced by train movement.

VARIABLE-SPEED, SINGLE-PHASE MOTOR.—In order to provide a motor which shall be simple and economical in operation, to obtain means for giving to it gradual acceleration and efficient speed control and to enable a plurality of motors to be governed from a single point at a distance from them, Mr. M. Milch has devised certain controlling circuits to be used in connection with a special form of induced compensated motor, for which a patent was granted to him August 23. The motor is of the commutator type, the rotor being provided with two sets of brushes, one set placed in mechanical line and the other in mechanical quadrature, with the direction of magnetization produced by the winding on the stator. The brushes of the former set are connected together, thus forming a short-circuited secondary to the stator winding as primary, while to the latter set of brushes is connected a source of e.m.f. variable at will by means of a suitable controller. The function of the controller is to supply to the latter set of brushes an e.m.f. decreasing with increase of speed, and to the stator terminals an e.m.f. having minimum value when the rotor is stationary and increasing as the speed increases. The active e.m.f's for both the rotor and stator are obtained through the controller from taps on an auto-transformer connected across the supply line. The rotor and stator windings form virtually a series circuit; but by reason of the presence of the transformer, the e.m.f. impressed upon the rotor must be in time phase with that impressed upon the stator, independent of the dynamo speed action of the moving secondary conductors, which action in the plain, compensated series-connected machine would give to the stator winding an e.m.f. in time quadrature to that impressed upon the rotor. The motor differs from the Latour type of machine only as regards the method of control.

DOUBLE-RATE ELECTRIC METERS.—A patent issued August 23 to W. H. Pratt covers a type of meter which is intended to register energy only when the flow thereof exceeds a certain predetermined limit. By use of an electrodynamometer which indicates the amount of energy flowing, the active meter is thrown into circuit only when the specified amount passes through the dynamometer, and the meter is cut out of circuit when the rate of consumption of energy is less than the fixed amount. The meter is intended to be used in cases where a certain flat rate is charged when the amount of energy does not exceed a certain value, and a certain other rate is used when the flow of energy is in excess of the limit determined upon.

SYNTONIC WIRELESS TELEGRAPHY.—The use of a telegraph circuit key and a telephone receiver is embodied in a wireless signaling system for which a patent was granted August 25 to Prof. M. I. Pupin. The dish in front of the permanent magnet of the receiver has a certain definite period of mechanical vibration, so that magnetic impulses received at intervals corresponding to this period will most readily produce a sound in the receiver. The impulses are regulated as to period by arranging the spark-gap in the transmitting circuit so as to allow oscillations to be set up only at the maxima points of the alternating electrical pressure obtained from an alternator. Thus, the oscillations will cause impulses to be propagated from the sending station at each instant when the e.m.f. of the alternator reaches maximum value, and only when the speed of the alternator corresponds to the mechanical vibrating period of the receiver disc will the receiver respond. A telegraph key in the alternator circuits serves the purpose of interrupting the impulses for various lengths of time, so as to render the signals intelligible.

LETTERS TO THE EDITORS.

Speed Control of Direct-Current Motors.

To the Editors of Electrical World and Engineer:

SIRS:—On the question of speed variation in direct-current motors we find in an editorial in your issue of August 20 the statement: "It is a fact which needs no proof that all other conditions being the same, the most satisfactory system is one which employs a variable-speed motor which relies solely upon shunt field resistance control." This, while not literally true, is true in a broad sense, as all systems of speed control for stationary motors ultimately reduce themselves to shunt resistance control. Multiple-voltage systems, double-commutator machines, etc., are merely devices to take care of speed variation, which is too great for satisfactory work by shunt control. But in all such systems full use is made of all the speed variation that can be obtained by shunt control, and if the whole needed variation could be commercially obtained by shunt control alone, we would hear no more of the special systems and devices.

This being the case, it becomes important when buying a motor for variable-speed work to know just what range of speed can be obtained under given conditions of operation. The statements made by the various manufacturers that their motors are capable of a speed variation of 2 to 1 or 4 to 1, as the case may be, are worthless except as an advertising feature, unless we know under what conditions they will operate with this speed variation. The speed variation that can be got from a motor is limited by the sparking of the machine at the high speeds. And the amount of sparking that a commutator will stand depends upon the proportion of the total running time that the commutator is subjected to that sparking. In the discussion on the papers on "Sparking in Direct-Current Machines," read at the last annual meeting of the American Institute of Electrical Engineers by Mr. E. H. Anderson and the present writer, Mr. Anderson pointed out very clearly that the reason why we can run a railway motor satisfactorily under very bad conditions as regards sparking, is that the commutator is not subjected to this sparking all the time. And that though the commutator is being roughened during a part of the time, during the remainder of the time (often amounting to two-thirds of the total time) the motor is running under conditions which allow of polishing of the commutator; so that the good behavior of the motor depends on the service being intermittent. Quoting from Mr. Anderson, "A railway motor on a particular duty may commutate well; but put it on another duty where the pressure and current are on somewhat longer, and the etching may be too great for the polishing, with the result that the commutator does not run well."

Precisely the same thing applies to variable-speed motors. Almost any standard motor is, in regard to sparking, capable of a speed variation of 10 to 1 by field control, provided it does not run for more than 1 per cent. of the time at the highest speed. But run that same motor continuously with its weakened field and it will not last a day. The amount of speed variation by field control allowable in any given motor, assuming the output in horse-power is the same at all speeds, depends on the proportion of the total running time that the motor runs with its weakened field. This is well exemplified by the following test made on a standard 30-hp, 500-volt, extra slow-speed motor, the speed being varied by field control and the load kept constant at 50 amp.:

Speed.	Shunt Current.	Remarks.
350	1.2	Good up to 75% overload.
500	0.7	Just good for continuous running.
650	0.45	Good only for running 33% of the time.
750	0.38	Good only for running 20% of the time.
1000	0.25	Good only for running 5% of the time.

The tabulation shows that this motor could be rated with an allowable speed variation at constant load of anywhere from 1.4 to 1 up to 3 to 1, according to the service that it was to be put to.

A motor sparks when run at a higher speed with a weakened field and constant load, (1) because of the increased frequency of commutator; (2) because of increased field distortion. All formulas for giving a predetermined estimate of the sparking of a machine take into account the frequency of commutation and assume that the greater the speed the greater the tendency toward sparking. Field distortion or the weakening of the strength of the commutating field due to the cross magnetization of the armature is greater in proportion, the stronger the armature and the weaker the fields. Excessive distortion is evidenced by the necessity for shifting the brushes to obtain satisfactory commutation as the load comes on the motor. Field distortion is kept down by running with a weak armature, by increasing the magnetic densities in the teeth and air-gap, and by increasing the length of the air-gap. It is obvious that from this that a motor speeded up and running with a weakened field is running under particularly bad conditions as regards sparking, and it is not to be wondered at that a standard motor will not stand much weakening of the fields.

There is no standard motor on the market that would run continuously on full load and give satisfaction when the speed is doubled by weakening the field, and we have no right to expect such a performance. Such a motor would be much too good at its standard low speed rating and would not be a commercial machine.

It is a perfectly simple matter to design a motor for any given service as regards speed variation, whether it is to be a 2 to 1 ratio, running at the highest speed for 1/10 of the time, or whether it is to be a 10 to 1 ratio, running at the highest speed for ⅔ of the time. But before designing any such motor or before rating any motor for speed variation, it should be definitely stated what percentage of the time it will run on the weakened field and what load it will carry under these conditions. And any broad statements about the speed variations to be obtained with a given line of motors are both useless and misleading unless these conditions are definitely stated.

MILWAUKEE, WIS. W. L. WATERS.

Flickering of Incandescent Lamps.

To the Editors of Electrical World and Engineer:

SIRS:—In your editorial on the flickering of incandescent lamps of low frequency in the issue of August 20, one cause of such flickering is not mentioned. In fact, I doubt whether it is generally known, for the reason that incandescent lamps are so seldom operated from 25-cycle circuits. When standing in front of one of the exhibit booths in Electricity Building at the Louisiana Purchase Exposition recently, my attention was attracted by the flickering of some incandescent lights which were placed in rows on each side of the entrance to the booth. The flickering in itself did not cause any surprise, because the source of supply was 25-cycle, alternating current, such as is used generally for the decorative lighting of the Exposition. What did attract attention was the fact that some of the lamps seemed to be flickering decidedly more than others.

As the lamps were enclosed in holophane globes it was, of course, impossible to tell what was going on inside of the globe, but upon removing the globe it was found that some of the lamp filaments were in a state of mechanical vibration, while others were not. The majority of the filaments were in vibration. Occasionally one would be found which was almost stationary. This vibration was not due to any vibration of the building, and must, therefore, be accounted for by the magnetic repulsion between the turns of the lamp filaments. Some filaments were evidently in such a state of mechanical tension that the magnetic repulsion between the turns acting fifty times per second, was able to set them in vibration. This mechanical vibration was in this case causing a much more annoying flicker than any variation in the light due to variations in the temperature of the filament. Thus it is seen that if incandescent lamps are to be operated at 25 cycles, it is desirable to have filaments of a character to increase the mechanical inertia, or so shaped or installed as to minimize the effect.

ST. LOUIS, MO. CHARLES L. DENT.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Standardization.—An interim report on generators, motors and transformers, issued by a committee of the (British) Engineering Standards Committee. After some general notes, pressures and frequencies are standardized as follows: For low-pressure, direct and alternating-current work the standard voltages are 110, 220, 440, 500, while 380 volts is to be considered as the recognized pressure to be maintained between the main conductors in a three-phase system with neutral wire, the pressure being then 220 volts between the three main conductors and the neutral. The standard voltages for high-tension, alternating-current work, measured at the terminals of the generator, are 2,200, 3,300, 6,600, 11,000 volts. The standard primary pressures for alternating-current transformers, measured at the primary terminals of the transformer, are 2,000, 3,000, 6,000, 10,000 volts. The standard secondary pressures for alternating-current transformer work, measured at the secondary terminals of the transformer, are 115, 230, 460, 525 volts at no load. The standard direct-current pressure for tramway work, measured at the terminals of the motor, is 500 volts. The standard frequency for alternating-current work is 50 periods per second; but where the circumstances of the case demand a lower frequency, a standard of 25 periods per second shall be adopted. Then follow rules on the rating of generators and motors. In an editorial note it is pointed out that since the report is intended as a guide for "all future work," a complete reversion of the existing installations to one single set of standards is not expected. For converter plants 25 periods is a better frequency than 50, and the increase in the cost of the converting plant on account of the lower frequency still leaves it cheaper than motor-generators.—Lond. *Elec.*, August 12.

REFERENCES.

Zone Dynamos.—JOEL.—The conclusion of his article on zone dynamos and motors. The results of some tests of machines of this type are given. It is thought that, owing to the suppression of the local short-circuiting currents under the brushes, and the absence of sparking, the zone construction is particularly adapted for use with dynamos driven by steam turbines at high speed, say 3,000 to 5,000 revolutions. It is also thought that this type is peculiarly adapted for variable-speed motors, where it is necessary to work with very weak fields at the highest speed.—Lond. *Elec. Rev.*, August 12.

Pressure Drop in Alternators.—CRAMP.—An illustrated article describing the determination of the voltage drop in alternators by graphical methods, using diaphragms like that of Heyland's.—Lond. *Elec. Eng.*, August 12.

Three-Phase Motors.—THOMAELEN.—An article on the geometrical construction of the diagram of the three-phase induction motor for predetermining the starting torque.—*Elek. Zeit.*, August 11.

LIGHTS AND LIGHTING.

Conduction of Electricity in Mercury Vapor.—WILLS.—An account of an investigation of the phenomena in the so-called "positive column" of the Cooper Hewitt mercury vapor lamp. He studied especially the relation between the conductivity of the vapor column and the vapor density, his method being essentially based on the fact that the density variation follows sluggishly the current variation. The results are given in tables and diagrams and it appears that, with the exception of values of the electromotive intensity (in volts per centimeter) corresponding to pressures less than half a millimeter of mercury, the relation between e.m.f. intensity and pressure may be fairly well represented by two intersecting straight lines. The point of intersection of these two lines corresponds to the pressure at which the walls of the tube seem to cease to exert a restrictive action upon the conducting vapor column. There are, therefore, two cases to be distinguished (corresponding to two different ranges of pressure); in the first case the walls of the tube exert a restrictive action upon the luminous column, while in the second case the luminous column is practically free of the walls of the tube. Empirical formulas are given by the author representing his results. The author finally discusses the relations between e.m.f. intensity and current and between e.m.f. intensity and diameter of tubes.—*Phys. Rev.*, August.

Electric Arc.—CHILD.—An account of tests of the electric arc at pressures less than one atmosphere. The author studied the potential gradient through the arc at decreasing pressures. The drop at the cathode passes through a maximum at about 100 mm. of pressure and then decreases, the larger part of the change occurring below 30 mm. pressure. The drop at the anode decreases quite uniformly as the pressure is increased, the rate of decrease being, however, greater below 50 mm. No change in the electric force between the electrodes was shown until a pressure of 50 mm. was reached; below this it decreased, being approximately one-half as great at 2 mm. as at atmospheric pressure. The temperature of the arc is apparently less at low pressures than at high, although at 0.5 mm. pressure platinum wire is still melted. The discharge from the arc to a surrounding cylinder was found to increase very rapidly as the pressure was decreased. The discharge carried by the positive ions is the greater at atmospheric pressure, that carried by negative the greater at low pressures. With respect to the theory of the arc, the author points out that a hot anode is not an essential requirement. Reasons are given for believing that the number of ions leaving the electrodes is not as great as those passing through the center of the arc. A high temperature is considered to be an essential requirement for ionization within the arc except when the pressure is very low. There the free path of the negative ions may be sufficiently great to allow ionization by impact.—*Phys. Rev.*, August.

Magazine Arc Lamp.—An illustrated description of a new magazine mechanism for open and enclosed direct-current or alternating-current arc lamps. It consists essentially of a revolving magazine, a change-over device with delayed action and an automatic bottom tubular carbon holder. The magazine is a cage revolving on a vertical axis and capable of holding 12 carbons. Each carbon is held in the magazine at the upper end by a weighted clutch holder. When a carbon has been consumed sufficiently, the gradual descent of the upper carbon brings the upper holder into contact with a fixed contact piece, completing a circuit containing a solenoid. This brings the mechanism into action.—Lond. *Elec. Rev.*, August 12.

Meridian Arc Lamp.—A note on a lamp made by a British company and designed to fill the gap between the ordinary incandescent lamp and the arc lamp. It is an incandescent filament lamp provided with a large spherical globe and translucent prismatic reflector, and its appearance when burning is that of a globe of soft, brilliant white light. While the maximum candle-power is about 58 at an angle of 30° from the vertical, an average candle-power of about 55 is maintained over an angle of 60°. The lamp is made in only one size, giving 55 cp and consuming 120 watts, and is supplied in voltages from 100 to 125. The bulb is spherical, 5 in. in diameter, and is always supplied frosted.—Lond. *Elec. Rev.*, August 12.

POWER.

Distribution System.—The conclusion of the long illustrated serial on the North Eastern Railway and Carville power house, dealing with the general power supply of the Newcastle Electric Supply Company. There are installed motors of an aggregate capacity of 6,500 hp in various workshops and shipyards, and the energy required for driving them is derived from twelve sub-stations, some of which also supply the North Eastern Railway and the three-wire distribution network of the supply company. Bulk supply is also given to various lighting and traction companies. Altogether the capacity of the entire transforming plant on the system is approximately 31,000 kw, without allowing for a 1,000-kw battery at one sub-station and for certain plants utilized for the retransformation of energy. In one of the largest installations 35 induction motors, from 2 hp to 75 hp, and aggregating 814 hp, are installed and a special sub-station has been put down for these works, containing four 110-kw, three-phase transformers. The principal feature of interest in these works are the cranes, all of which, with the exception of two recent ones, have been converted to electric from square shafting drives. No fewer than sixteen cranes are driven electrically, fourteen being operated by single motors of the squirrel-cage type; the other two are provided with three motors each, the motors being of the variable-speed type, with slip rings connected to a controller.—Lond. *Elec.*, August 12.

REFERENCES.

Power Transmission in Spain.—A note stating that the city of Bilbao is to be supplied with electrical energy from three water power stations, of which one is already in operation, being equipped with four 1,000-hp sets. At a speed of 375 r.p.m. the generators produce current at 3,000 volts, which is raised by step-up transformers to 30,000 volts for transmission to Bilbao.—Lond. *Elec.*, August 12.

Electric Crane for Southampton Graving Dock.—A description of this 50-ton crane, which is operated by five motors, all of which are completely enclosed and are run from a 480-volt, direct-current circuit. For lifting, two motors are provided, each of 50 hp, governed by a series-parallel controller; for the derricking motion there is used one 80-hp series motor, for the slewing motion one 25-hp series motor, and for the traveling motion one 50-hp series motor.—Lond. *Eng'ing, Elec., Elec. Rev.*—August 12.

TRACTION.

REFERENCES.

London.—The first part of an illustrated article on power supply for the tramways in North London. The station at Brimsdown is the first in England to supply current at 11,000 volts for tramway purposes. The present installment gives a description of the boiler house and engine room.—Lond. *Elec.*, August 12.

Railway Signals.—FREY.—A fully illustrated article on the use of electric lamps for railway signals, with special reference to those installed in the Gotthard tunnel. It is stated that the cost of maintenance and operation is less than with kerosene lamps.—*Elek. Zeit.*, August 11.

Trolley Ear.—A description of a new trolley ear, the feature of which is that it is secured in the insulator by a wedge, which extends into a sleeve on the insulator, where it is held in place by a cotter pin. —*St. R'y Jour.*, August 13.

Change Speed Gear for Automobiles.—PFEFFER.—An illustrated article with dimensional drawings on the design of a change speed gear for motor-driven vehicles. The design is similar to that used on various types of touring cars, ranging from 20 to 30 hp, and is constructed so that it may be readily adapted to any side-chain-driven car without any change in detail. There are three forward speed gears and one reverse.—*Am. Elec.*, August.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Lighting Plant of a Large Office Building.—An illustrated description of the generating equipment of the Whitehall Building, in New York. The power plant is divided into two parts, one consisting of three pumps, which operate six hydraulic elevators and supply hot water to the whole building; the other consisting of three direct-connected electric units having an aggregate capacity of 615 hp. The current is used entirely for lighting. This is done in the two-wire system and over 6,000, 230-volt incandescent lamps are connected in circuit. The normal lighting load is 100 amp., which increases to 800 amp. during the winter days.—*Am. Elec.*, August.

Derby.—An illustrated description of the present equipment of the Derby Electric Tramway & Lighting Supply Station. From the old equipment installed in 1892 only the arc lighting dynamos of the direct constant-current type are left. The newer machines are three 700-kw, two 150-kw and three 300-kw sets. The latter three are steam turbo-alternators running at 3,000 r.p.m. There are also installed two batteries, one for lighting and one for traction. Each battery consists of 240 cells and the capacity of each battery is 350 amp. on a one-hour's discharge, or 600 amp. when discharged in six hours. For the traction system reversible boosters are used in series with the battery, both being in parallel with the generators.—Lond. *Elec. Eng.*, August 12.

Small Central Station.—A well-illustrated description of the Leek electric plant, which is driven by town gas. It contains two horizontal, single-cylinder gas engines, each capable of developing 100 hp, coupled directly to two 60-kw dynamos. There are two batteries of 128 cells each, 21 of which are used as regulating cells, having a capacity of 300 amp.-hours. Two boosters are provided for charging the batteries, each having a capacity of 6 kw.—Lond. *Elec. Rev.*, August 12.

ELECTRO-PHYSICS AND MAGNETISM.

N-Rays.—BECQUEREL.—An account of some recent discoveries in this field. He shows that the N-rays and N^1-rays given out by certain bodies, such as compressed wood or calcium sulphide exposed to sunlight, can be completely deflected by a magnet, while the N-rays given out by a Nernst filament are not affected even by a field of 10,000 magnetic units. The N-rays are, as a rule, identical with the β-rays of radium, and the N^1-rays with the α-rays of radium, except that the magnetic curvature of the N^1-rays is the same as that of the N-rays. The nature of the N-rays emitted by a Nernst filament has not yet been accounted for; they affect the sulphide screen, but are not deflected by a magnet and have a definite series of very small wave lengths. These are refracted by an aluminum prism and seem to give rise to the α-rays and β-rays. The latter are free negative electrons, while the former behave like free positive electrons. He also describes some experiments, which enabled him to obtain either N-rays or N^1-rays from the non-deflected N-rays left after the rest had been deflected off by a magnet. He establishes a rule connecting the N-rays with the N^1-rays. A surface capable of storing the N-rays emits N-rays normally and N^1-rays tangentially, and vice versa.—*Comptes Rendus*, July 25; Lond. *Elec.*, August 12. The latter journal also contains a long editorial on the subject, in which it is pointed out that nearly all physicists outside of France have remained sceptical, yet the theoretical interest of the investigations of N-rays is very great. We have apparently to deal with light of extremely minute wave length (of the size of a molecule and about one-fiftieth of the wave length of visible light). This means an enormous extension of the known spectrum in the violet direction. Taken together with the investigation of radium rays, the N-rays should enable us to get a distinct conception of the structure of atoms. In radium rays we deal with the projection and impact of electrons; in N-rays we probably have the ether disturbances which accompany these processes.—Lond. *Elec.*, August 12.

ELECTRO-CHEMISTRY AND BATTERIES.

Thermo-Electromotive Force in Nickel Nitrate in Organic Solvents.—MEYER.—An account of an experimental investigation, the main results of which are as follows: The thermo-electromotive force of nickel nitrate in analine and pyridine with platinum electrodes is zero through a temperature range of about 80° C. In solutions of nickel nitrate in alcohol the heated electrode is first positive and becomes negative toward the cold electrode, while in acetone solutions the heated electrode is always positive. The thermo-electromotive force is independent of the concentration from one-tenth to one-fiftieth normal. Polarization effects cannot be avoided, and they are large enough to mask the thermal effects in the measurements. A method that would employ no current is the only one that seems entirely satisfactory for measuring the very small differences of potential.—*Phys. Rev.*, August.

Porous Diaphragm.—PERKIN.—A Faraday Society paper and a new form of diaphragm for electrolytic cells. The cell consists of two portions of wedgewood or salt-glazed, one fitting within the other. These two cells are perforated and serve as a support for the porous material, which is placed between them. For this purpose

blotting paper, asbestos paper, sand or coarsely powdered glass may be used.—*Electrochem. & Met.*, July.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Comparing Inductances or Capacities by the Differential Telephone.—Ho.—An illustrated article with reference to a recent paper of Duane and Lory. In winding a differential telephone, it is necessary to adjust the two coils so as to be exactly equal in their inductance, resistance and magnetic effect. For this purpose he winds two similar wires in twin; that is, always side by side, and as close together as possible from beginning to end. The two coils thus made are perfectly equivalent in their magnetic effect, and the ohmic resistance also generally requires little adjustment; moreover, in the state of balance; that is, when equal and opposite currents are flowing through these coils, their inductances are completely balanced by the mutual inductance and they act as non-inductive resistances; in any calculation they may, therefore, be treated like simple non-inductive resistances, and if shunted with non-inductive resistances, the ordinary calculation for shunt connections may be employed. For comparing inductances, he considers the "series connection" preferable to the "shunt connection" of Duane and Lory. The "series connection" is shown in Fig. 1. Suitable non-inductive resistance,

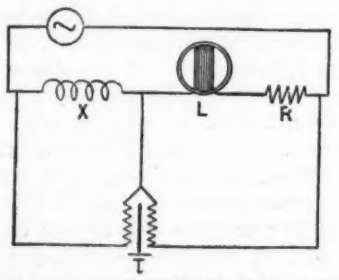


FIG. 1.—COMPARING INDUCTANCES OR CAPACITIES.

R, is added either to L or to X, as the case requires, to make them perfectly equal in resistance; this adjustment is done with an ordinary mirror galvanometer. L and X are the two inductances, X is inductance to be determined. The differential telephone, T, is connected with proper consideration of the relative direction of currents in the coils, to L and X, and the system is connected to a source of alternating current. L is varied till no sound is heard in the telephone, under which condition $L = X$. If X is below the range of L, the resistance of L is made m times larger than that of X, and also the resistance of the telephone coil corresponding to L is made m times larger than that of the other coil, by addition of suitable non-inductive resistances. In this case the ratio of X and L that gives balance is $1 \div m$. If X is above the range of L, the reverse is done. For comparing two capacities, C_1 and C_2, by means of the differential telephone, the arrangement of Fig. 2 is used, in which R is a variable

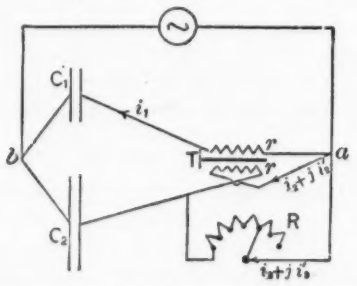


FIG. 2.—COMPARING INDUCTANCES AND CAPACITIES.

resistance, preferably with sliding contact, which shunts one of the telephone coils in series with the larger capacity. R is varied till no sound is heard in the telephone, T, in which condition $C_2 \div C_1 = (r + R) \div R$. By using an e.m.f. of about 500 volts, he could measure capacities less than one-millionth of a microfarad in comparison with a parallel plate air condenser. The author believes that the differential telephone should become one of the most necessary instruments in many branches of electrical measurement.—*Phys. Rev.*, August.

Calibration of Recording Wattmeters.—HANCHETT.—An article giving many convenient ways of testing a wattmeter. The most primitive of these is to burn a number of lamps for an hour, reading the meter before and after the test. The 3½-watt, 16-cp lamp consumes about 56 watts, and if ten lamps are burned for an hour the meter should indicate approximately 560 watt-hours. Any gross error, such as one of 30 or 40 per cent., can be detected in this way. For closer work tests can be made in several different ways. These are divided into two classes, the revolution method and the test by dial readings. Both of these methods are described.—*Am. Elec.*, August.

Magnetic Contact Maker.—SHEDD.—A description of a contact maker, the construction of which may be seen from Fig. 3. A is the lower end of a clock pendulum. B is a permanent magnet made up of laminæ separately magnetized before assembling. $C\,C$ are soft-iron laminated armatures, mounted on springs, $D\,D$, which are adjustable by the screws, $M\,M$. The contact point is at E and consists of a platinum point playing against a small gold plate. This is adjustable by the screw, G. The magnet, B, has its plane perpendicular to the plane in which the pendulum swings. The drawing together of the armatures at each swing of the pendulum is short and sharp. Since the action is continuous the rate of the clock, once adjusted, is not further affected; and since the action occurs at the middle of the swing the effect due to this cause is negligible.—*Phys. Rev.*, August.

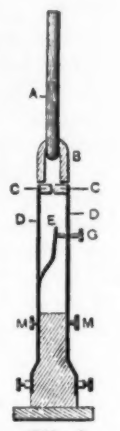


FIG. 3.

REFERENCES.

Electrical Notation.—A full report of discussions held at several meetings of the Berlin Electrical Societies; the speakers were Strecker, Bauch, Meyer, Emde, Benischke, but no decision was reached. The discussion dealt to a great extent with details. For electric resistance Bauch wants to use the letter R, while Benischke and the majority of the committee prefer W (from the German word Widerstand). The conclusion was finally reached to discuss the matter further in the technical press. The same issue contains a communication by Schreber, who thinks that it is impossible to get uniformity of notation in science and engineering, and that the time devoted to such discussions could be spent to better advantage for scientific investigations.—*Elek. Zeit.*, August 11.

Units.—ROBERTSON.—A translation in abstract of the recent paper of Emde, with an analysis of his method of representing the various systems of electrical units; no conclusions are reached.—Lond. *Elec.*, August 12.

Silver Voltameter.—GUTHE.—His complete paper on the most reliable forms of the silver voltameter, an abstract of which was recently noticed in the Digest.—*Phys. Rev.*, August.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Telephone Engineering.—DOMMERQUE.—A short article dealing with the cost of aerial cable lines, which is usually expressed in dollars per mile. The mile unit, the author claims, is too great, as in practice a mile of uniform cable line is hardly ever found. Sometimes the size changes several times in a mile of pole line; sometimes there is open-wire construction on the same line; now and then a cable box is inserted, and so on. To form a reasonably correct idea of the cost of aerial cable lines requires an account of all these variations that may occur. The author gives some suggestions which might assist in estimating the cost.—*Am. Elec.*, August.

Barretter.—DIECKMANN.—An account of an experimental investigation of the Schlömilch wave detector for wireless telegraphy (which is quite similar to the Fessenden barretter). The author describes experiments which prove that the action is due to polarization phenomena at the electrode.—*Phys. Zeit.*, August 15.

Fire Alarm Circuits.—DIAMANT.—An illustrated article on fire alarm circuits, controlled from a central station. The cycle of operation of the fire alarm circuits and the manner of immediately having the apparatus dispatched to the scene of fire is explained by aid of a general plan and detailed diagrams.—*Am. Elec.*, August.

MISCELLANEOUS.

Effect of Radium Rays on Bacilli.—PRESCJ.—An account of experiments which prove that radium rays have no effect whatever upon fresh culture of bacilli, especially on that of diphtheria, at a distance of 1 cm., when the time of exposure is less than 90 minutes. On the average the therapeutic use of radium must be explained in

some other way than by the direct weakening or destruction of the microbe organisms of disease. The use of radium tubes in the treatment of diphtheria cannot be recommended or regarded as a substitute for antitoxin.—*Science*, August 19.

REFERENCES.

Manufacturing Plant.—The conclusion of the fully-illustrated description of the works of the General Electric Company in Schenectady. This installment deals with the construction of the Curtis steam turbine and gives a description of the experimental railroad track and an account of experiments made on single-phase traction. The wire and cable department and the power station are briefly described and some notes are given on miscellaneous other departments.—Lond. *Eng'ing*, August 12.

Municipal Electrical Engineering.—BLAKEWAY.—His paper on the financial position of municipal electrical undertakings in Great Britain, an abstract of which was recently noticed in the Digest. A full report is also given of the discussion which followed.—Lond. *Elec.*, August 12.

Exhibition.—The conclusion of the illustrated article on the colliery exhibition. This installment deals with cables and accessories. —Lond. *Elec. Rev.*, August 12.

Wireless Telegraph Service in St. Louis.

BY CLOYD MARSHALL.

Experimental and development work in wireless telegraphy has been done almost exclusively at sea or lake ports, but the Exposition has been the means of making St. Louis, which is far inland, one of the most important fields for wireless telegraphy. Numerous stations have been established on the Exposition grounds, two of the St. Louis papers have wireless telegraph equipments and receive considerable news by that means, and long-distance overland experiments are being conducted between St. Louis, Springfield and Chicago. Several systems are on exhibit, notably the De Forest, Marconi and the Ducretet, but the former is the only one which has put forth zeal to carry on scientific and commercial work. The arrangement of the De Forest exhibit in the Electricity Building was described and illustrated in the ELECTRICAL WORLD AND ENGINEER of May 14. In addition thereto, it may be said that the power supply for sending messages is 60 cycles alternating current from the Machinery Building, from which 110 volts are used for the wireless telegraph transmitter. A 2-kw transformer raises the potential to 20,000 volts, the secondary being connected to 18 jars of .013 microfarad capacity, to the helix, antennæ and to earth. The accompanying diagram shows the circuits of the system. Such an equipment is suitable for sending messages 300 miles over water and about 100 miles over land.

FIG. 1.—WIRELESS TELEGRAPH AUTOMOBILE.

The cut (Fig. 1) shows one of two wireless telegraph automobiles exhibited, one in the Electricity and the other in the Transportation Building. The storage battery furnishes power for propelling the automobile and operating the telegraph apparatus in the case above. These have been successfully used for sending stock quotations from the New York Curb Exchange to the brokers' offices in Broad and Wall Streets.

The installation in the Electrical Building is a model of the station now being erected at Cape Flattery, Wash., and is intended primarily for demonstration purposes. The operators receive and send messages to the long-distance station about a half mile away or to the station in the space of the Fort Wayne Electric Works, which is about 400 ft. distant.

In the Government Building there are three complete sets of instruments. The exhibit of the United States Patent Office includes seven

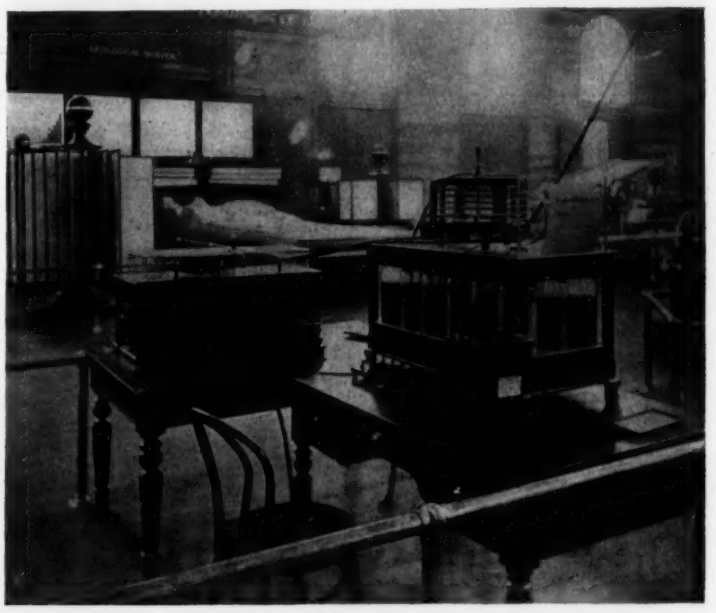


FIG. 2.—APPARATUS IN GOVERNMENT BUILDING.

recent inventions which have been chosen as representative of American genius, and one of these is the De Forest apparatus for receiving and transmitting electromagnetic waves. The Government Building has been the most popular exhibit palace at St. Louis, because it contains those things in which the Government touches the daily life and work of the people. The new inventions receive their full share of attention and none more than the wireless telegraph apparatus. In this station a Wagner 110-volt motor-generator of 1 kw-capacity is used to convert the current from 25 cycles, which is the original supply, to 60 cycles, which is more suitable for sending the messages. In the same building the United States Signal Corps has two wireless sets in operation. These are fully demonstrated and explained to all visitors, which is characteristic of the Government Building, and is a potent reason for the popularity for all exhibits therein.

Dr. Lee De Forest had the utmost confidence in the possibility of transmitting messages long distances overland. In order to carry on these experiments on a greater scale than heretofore attempted and to prepare for commercial service, there was erected under his direction a 200-ft. mast on Art Hill at the highest elevation on the Exposition grounds. Along the 40-ft. cross arm at the top of the mast is strung a horizontal wire from which 20 verticals are suspended. These antennæ wires average 250 ft. in length, being bowed out from the mast by means of cord spreaders. The antennæ enter the roof of the building in two portions of ten wires each, and from these wires the messages are sent, the receiving antennæ being entirely distinct in a building 20 by 40 ft. near the foot of the mast, which contains the operating cable, relay keys and receiving instrument. In a separate room are the condensers, transformer, helix and other paraphernalia. There is a muffler about the spark-gap which deadens

the deafening sound coming from the explosions accompanying the arc.

At this station 25-cycle, alternating current only was available. A 20-kw Fort Wayne transformer built for 60 cycles operates very well on the lower frequency, but there is a drag at the key which

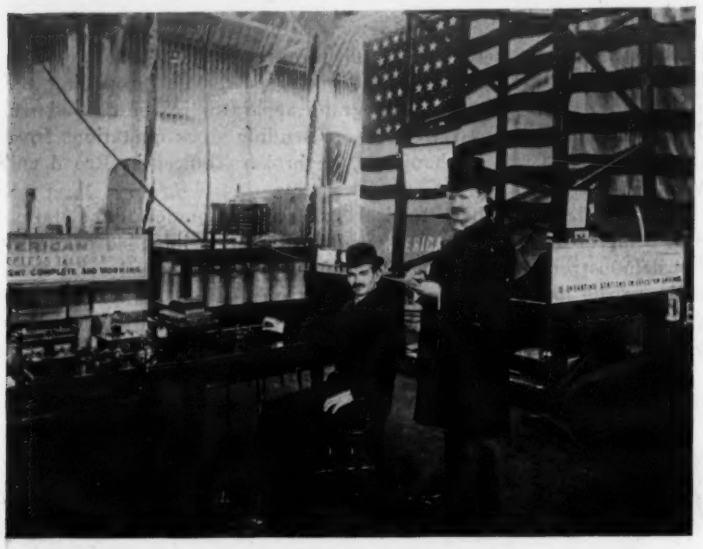


FIG. 3.—DE FOREST WIRELESS TELEGRAPH EXHIBIT.

would not occur with the higher frequency current. A Wagner motor-generator running on 25 cycles is installed to furnish 110 volts direct current used to operate the relay key, which breaks the main circuit. Messages have already been sent from this station to Springfield, Ill., 105 miles away, where a similar installation has

FIG. 4.—DE FOREST TOWER STATION.

been made. The ground plate at the long-distance station consists of 140 sq. ft. of copper plate, buried 8 ft. directly below the station. Means are provided for maintaining this in a constantly damp condition.

The greatest undertaking of the De Forest Company has been the erection of a 300-ft. steel tower to be used for a wireless telegraph station and for observation. This steel structure was formerly at the Tower Hotel, Niagara Falls, and when it was purchased by the wireless telegraph company it was dismantled and erected at the entrance of Orleans Plaza. It is the tallest structure on the Exposition grounds and is a popular place for getting a birdseye view of the main picture of the Fair. Two electric elevators carry passengers to the wireless telegraph station on the 100-ft. platform and to the two observation platforms at the top. The power supply is 500

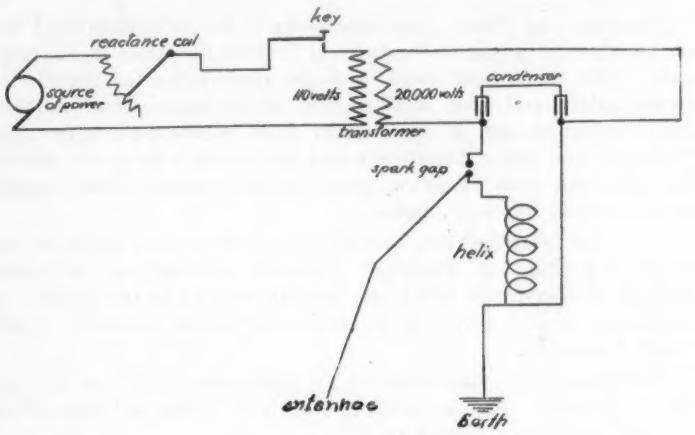


FIG. 5.—ARRANGEMENT OF CIRCUITS.

volts direct current, which is transformed by a 70-hp motor-generator to 240 volts for driving the elevator motors.

At the tower station a 240-volt motor is belted to a 2-kw, 60-cycle, 110-volt alternating-current generator, which is the voltage used for the wireless telegraph transmitter. A transformer raises the voltage to 20,000.

The illustration shows the keys, condensers, helix and antennæ cable. The speed with which the Morse key of the transmitter can cut the 60-cycle current into the dots and dashes of the telegraph code is equal to that attained over any land wire. The apparatus is grounded on the frame of the tower itself, which makes the wave length of the antennæ considerably longer than if it were suspended from a wooden structure and the ground made in the ordinary manner.

From the tower station a regular daily news service is rendered to the St. Louis *Post-Dispatch* and the St. Louis *Star*. From three to five thousand words of press copy per day are transmitted at a rate of 25 to 35 words per minute, detailing such World's Fair news as the newspaper reporters can collect upon the Exposition grounds. Although the steel frame of the tower renders the station inefficient for wireless telegraph transmission, yet the service has been wholly satisfactory and messages are being received from the station at Springfield, Ill., over 100 miles away.

California Water Powers.

Thousands of miles of pipe lines traverse California and make possible the utilization of water under pressures heretofore unheard of in actual practice. As an instance may be cited the plant of the Edison Electric Company, near Redlands, in the southern part of the State, where a Pelton water wheel is operating under a head of 1,950 ft., equivalent to 850 pounds pressure per sq. in. This wheel is direct-coupled to an electric generator of 1,000 hp capacity, and the current is transmitted to Los Angeles. The station is only one of many controlled by this electric system, which has a large number of Pelton wheels in use, under heads ranging from 100 ft. up to the above named, 1,950 ft.

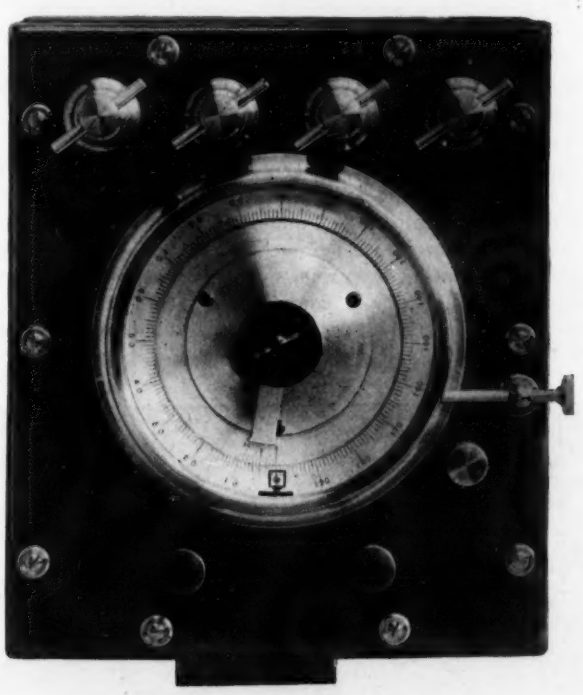
The demand for cheap power, together with the advantages of water at hand, naturally enough led to the development of a water wheel to supply the connecting link; and it was a pioneer Californian, L. A. Pelton, who first conceived the idea of a water wheel to operate under high heads. In the days of "'49" this wheel was called the "Hurdy-Gurdy" wheel, and consisted of a wooden rim, to which was bolted cast-iron cups, or "buckets," as they are technically called. The water impinging on the buckets, through a round nozzle, caused the wheel to revolve, and the peculiar shape of the buckets enabled a high useful effect to be obtained from the water. Later on fundamental patents were acquired by the Pelton Water Wheel Company, who, by experiment, further developed the original idea—of course, making radical changes in design and construction—and succeeded in producing a wheel from which ex-

traordinary results are obtained. An efficiency of 90 per cent. has been reached by the use of this wheel, which, however, was under most favorable conditions; but efficiencies of 80 and 85 per cent. are, it is said, easily realized in actual practice.

The Pelton Water Wheel Company, with headquarters in San Francisco, has built up a large industry in the manufacture of water wheels alone, having given exclusive attention to this specialty. In the last sixteen years it has installed over 11,000 wheels, aggregating in excess of 1,000,000 hp—the power ranging from a fraction of 1 hp up to 10,000 hp in a single wheel unit. It is indicative of American enterprise that one may find this California machinery product in use for driving fans in a bungalow in India and, again, for operating a 30,000-hp electric plant in Oregon.

New Standard for Checking Meters.

To facilitate rapid checking of integrating wattmeters and to insure accurate results, the Westinghouse Electric & Manufacturing Company has designed a special "Precision" wattmeter illustrated herewith. It has the same general characteristics of high accuracy, freedom from influences of external fields, the closeness with which observations may be made, and ease of manipulation characteristic of the other Westinghouse instruments of precision, and has a special provision by which connections may be made for three different currents, of 5, 20 and 100 amp. maximum capacity, respectively. The



PRECISION WATTMETER.

"Precision" resistance or multiplier is used in connection with this instrument, which, with resistance in circuit suitable for 100 volts, will accurately measure quantities of from 10 to 10,000 watts, and proportionate amounts at other voltages.

This instrument is easily manipulated. The construction of the binding posts facilitates making quick connections and insures good contact. When current is passed through the circuits the sight wire moves to the right, and is brought back to zero by turning to the left the central knob, which moves the vernier head along the scale. A fine adjustment is obtained by the knob at the side. Readings are made in tenths of a division without estimation, giving, in the instrument shown, 2,000 readable deflections on a five-inch circular scale.

In designing this instrument, the intent has been to provide a single checking standard that will cover the entire range of all the service wattmeters used in the ordinary installation, and thus to avoid the use of several standards, with the accompanying disadvantages and inconvenience in handling. By agreeing to keep this and other instruments of precision correctly calibrated for five years, the Westinghouse Company further seeks to eliminate any trouble caused by inaccuracy or doubt of the correctness in the standards themselves.

De Laval Steam Turbines at St. Louis.

In the issue of the ELECTRICAL WORLD AND ENGINEER for June 4, 1904, mention was made of exhaustive tests upon centrifugal pumps designed by the De Laval Steam Turbine Company. These pumps

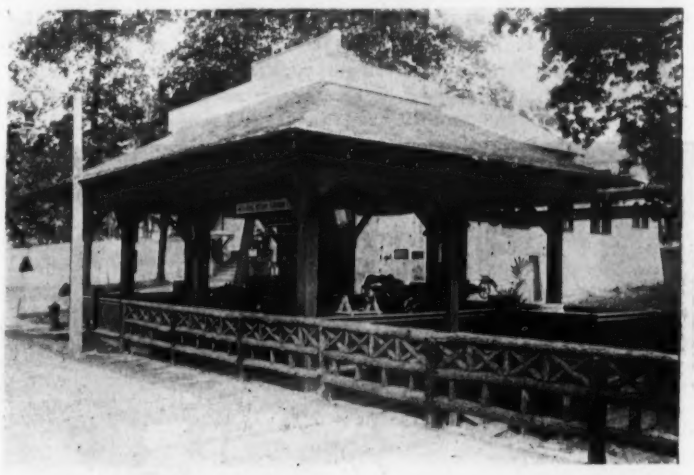


FIG. 1.—DE LAVAL BUILDING.

have been placed on exhibition in the building of the company, which is located in the Mining Gulch at the World's Fair, St. Louis. The accompanying illustrations show the interior and exterior of the building, in which is exhibited the following machinery: One 30-hp, 20-kw steam turbine dynamo; one 20-hp, electro-motor, centrifugal pump; one 55-hp, steam turbine, centrifugal, low-pressure pump, and one 58-hp, steam turbine, centrifugal, high-pressure pump.

The machines are shown in actual service, steam being furnished

FIG. 2.—INTERIOR OF DE LAVAL BUILDING.

by the Exposition authorities. The 20-kw steam turbine dynamo supplies electricity for operating the electro-motor pump. Under tests the pumps showed an efficiency of about 76 per cent., which is considered excellent for this class of machinery.

Hotels for St. Louis Meetings.

The Forest Park University Hotel will be the meeting place of the Northwestern Electrical Association, which convenes in that city beginning September 12. The hotel is easy of access to the grounds, being opposite what is known as the States buildings' entrance. The hotel is easily reached from the Union Station and is one of the best appointed near the Fair grounds.

The Grand View Fraternal Hotel, situated at Clayton and Oakland Avenues, will be the headquarters of the International Association of the Municipal Electricians. One of the entrances to the Fair grounds is directly across the street. One of the stations of the Intramural Railway is just inside the gates. A few minutes' walk from the hotel brings the visitor into the center of the Fair grounds. Every effort is being made not only to make the stay of the Municipal Electricians as pleasant as possible, but to cater particularly to the members of the great fraternities.

Exhibit of Steam Specialties.

One of the most complete and attractive exhibits of steam specialties at the St. Louis World's Fair is that of the Schaeffer & Budenberg Manufacturing Company, of Brooklyn, N. Y. This display is quite bewildering in its extent and detail and its arrangement is well planned. It includes a very complete line of pressure and vacuum gauges for all uses, steam engine indicators, planimeters, pyrometers, etc. Other devices of interest to engineers and steam

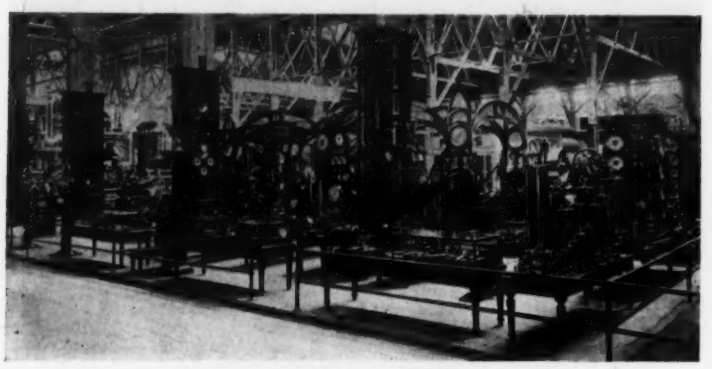


EXHIBIT OF STEAM SPECIALTIES.

men are the tachometers, speed indicators, dynamometers, steam traps, etc., which are arranged and displayed with good taste. The electrical engineer is as much interested in this exhibit as is the steam engineer, for here are found an extensive variety of appliances used in connection with his work.

Terrace Sight-Seeing Automobile.

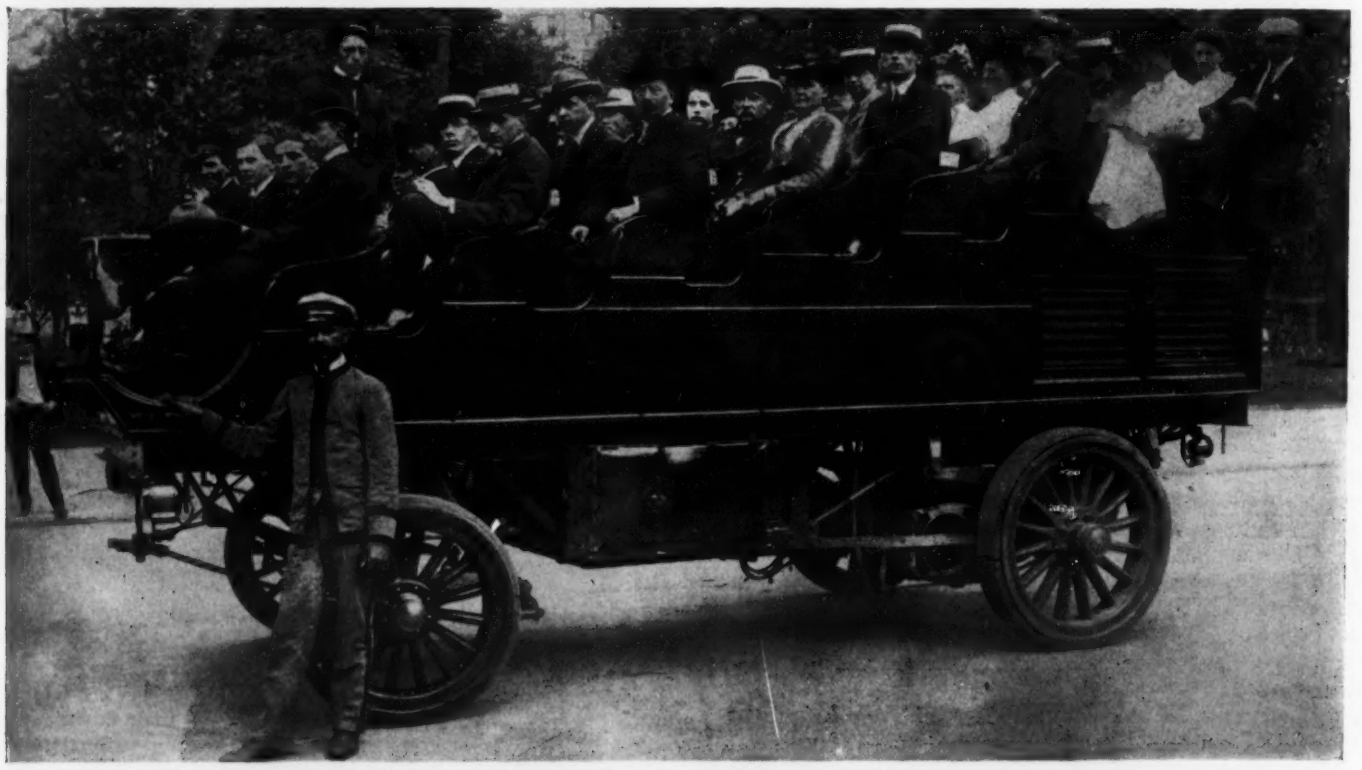
Heretofore in the vehicles built for the sight-seeing business, the seats have been so arranged that the passengers in front got the better view, while those on other seats were placed at a disadvantage. In the autocar, which forms the subject of the accompanying illustration, every passenger secures an unobstructed view and is allowed to occupy a box seat whether he be the first or the last to obtain admission to the car. The terraced arrangement of seats possesses the advantage of giving to the auto a pleasing appearance and does away with the flat-car effect of other vehicles in general use for sight-seeing purposes. The machinery is placed in the room rendered available underneath the rear seats, thus eliminating any odor from the engine and reducing the noise to a minimum.

In the vehicle illustrated, each seat is raised about five inches above the one immediately in front of it. In loading, the centers of all the seats except the rear one are removed, and the passengers are allowed to enter from the front. There are eight rows of seats, seating five passengers comfortably in each, but in case of emergency six passengers could ride in each seat, making the total number of passengers forty-six, exclusive of the operator.

The operating equipment includes all types of apparatus employed in a gas-driven, direct-current storage battery installation. The prime-mover is a four-cycle, 5⅛ by 6½-in. opposed horizontal cylinder gasolene engine designed to run at 550 r.p.m. This engine is fed from a gasolene tank having a capacity of twenty-eight gallons, sufficient for a run of 90 to 100 miles. Jump spark ignition is used, the induction coil being placed near the engine, but operated from the driver's seat. Lubrication is by means of a positive feed capillary mechanical oiler driven directly from the engine. The crank case of the engine is extended so as to form a sub-base for a 10-kw, 120-volt, shunt-wound dynamo, thus making a self-contained generating unit.

The generator feeds current into a battery consisting of forty-eight cells with a capacity of 136 ampere-hours at a three-hour rate. The motors are series wound, designed for 7½ hp normal and will stand an overload of 100 per cent. for one hour or 200 per cent. for a half hour. An automatic magnetic throttle governs the engine according to the demand of the motors, regardless of the speed of the vehicle.

The frame of the chassis is built up of channel steel. The wheels are of the artillery type, made of wood with solid rubber tires, 36 by 6 in. front, and 42 by 7 in. rear. The front axle is built up of wrought iron on the bridge truss principle, giving the greatest possible strength for the amount of material used. The rear axle consists of a diamond-shaped steel frame supporting two electric motors, necessary gears, housing for same, spring saddles, brake mechanism and live axles, all making a complete self-contained driving unit. Steering is done by means of a horizontal hand wheel operating through a pinion rack and a connecting arm to a knuckle arm.



TERRACE SIGHT-SEEING AUTOMOBILE.

The "terrace" is the first of four which the Fischer Motor Vehicle Company, Hoboken, N. J., is building for the New York Auto Transfer Company, and the equipment throughout is the regular Fischer combination system.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Speculation was active and bullish in character, notwithstanding the existing uncertainty in the crop situation and unsettled foreign markets on threatened political complications. Further advances are noted in different parts of the list, a tendency being shown to take up various neglected stocks. United States Steel issues, however, held firm in face of further talk of price cutting. The moderate improvement in the earnings of various railroads had a favorable effect. Money continues easy notwithstanding the increasing shipments to the South and West for crop movement. Traction stocks are still strong, though less active, there being a lull in the reports about the pending deal in these properties. Brooklyn Rapid Transit gained strength on the rather favorable annual report. Amalgamated Copper was the feature in the industrial list, making a further advance to 57¼ on indefinite reports regarding the property and the copper situation in general. Dullness prevailed in the electric list, and what changes are recorded are on the negative side. Allis-Chalmers is unchanged at 11; so is Westinghouse common at 159. Westinghouse pfd., however, made a net gain of 5 points, closing at 185. General Electric lost 1 point, closing at 164. In the traction group Brooklyn Rapid Transit, closing at 53⅞, made a gain of 1½ points, while Metropolitan Street Railway gained 1⅛, closing at 122¾. There was considerable activity in outside securities on the curb market, and a majority of the issues were strong. The closing prices were a little easier. Electric Vehicle common made a gain of 2¾ points, closing at 12¾, and the preferred 6½ points, with 20 as the last quotation of the week. Interborough Rapid Transit advanced with the other traction stocks, gaining 2 points on the week's business, the last quotation being 148. Following are the closing quotations of August 30:

NEW YORK

	Aug. 23	Aug. 30		Aug. 23	Aug. 30
Allis-Chalmers Co.	10¼	11	Electric Vehicle	10½	13⅛
Allis-Chalmers Co. pfd.	47	47	Electric Vehicle pfd.	16⅝	18
American Tel. & Cable.	89	89	General Electric	163½	165
American Tel. & Tel.	137	137⅛	Hudson River Tel.	...	...
American Dist. Tel.	22	22	Interborough Rap. Tran.	147	148
Brooklyn Rapid Transit.	53⅜	54⅜	Metropolitan St. Ry.	121⅞	119¾
Commercial Cable.	180	180	N. Y. & N. J Tel.	152	153½
Electric Boat.	39	39	Marconi Tel.	...	...
Electric Boat pfd.	66	70	Western Union Tel.	89⅝	89¾
Electric Lead Reduction.	⅛	⅜	Westinghouse com	158	160
			Westinghouse pfd	181	180

BOSTON

	Aug. 23	Aug. 30		Aug. 23	Aug. 30
American Tel. & Tel.	138		Western Tel. & Tel. pfd.	91	90¾
Cumberland Telephone.	117½	117¼	Mexican Telephone	1⅛	1¼
Edison Elec. Illum.	281	260*	New England Telephone.	123¾	125
General Electric	164⅛	165	Mass. Elec. Ry.	15	14
Western Tel. & Tel.	14	13½	Mass. Elec Ry. pfd.	63	63⅛

PHILADELPHIA.

	Aug. 23	Aug. 30		Aug. 23	Aug. 30
American Railways.	49	48¼	Phila. Traction.	98⅞	99
Elec. Storage Battery.	59	60	Phila. Electric.	6⅜	6⅝
Elec. Storage Battery pfd.	59	60	Phila. Rapid Trans.	13	14⅛
Elec. Co. of America.	9¼	9¼			

CHICAGO

	Aug. 23	Aug. 30		Aug. 23	Aug. 30
Central Union Tel.			National Carbon pfd.	110	112
Chicago Edison.	145	145	Metropolitan Elev. com.	19	21
Chicago City Ry.	170	180	Union Traction.	4¾	7¼
Chicago Tel. Co.	122	120	Union Traction pfd.	*30	33
National Carbon.	33¾	38			

*Asked † Holiday

NIAGARA FALLS POWER COMPANY.—The annual report of the Niagara Falls Power Company for the year ended June 30, 1904, is as follows:

Gross	$1,126,423
Expenses	214,530
Net	$911,893
Other income	114,936
Total income	$1,026,829
Charges, taxes, etc.	792,560
Balance	$234,269
Improvements and betterments	74,331
Surplus	$159,938

The general balance sheet as of June 30, 1904, follows: Assets—Real estate, power houses, etc., $15,251,811; securities of other companies, $3,210,641; 6 per cent. debentures and debenture coupons, $3,200,000; current assets, $1,058,755; deferred assets, $59,415. Total, $22,582,623. Liabilities—Capital stock, $4,180,700; bonds, $16,002,000; current liabilities, $815,240; franchises, licenses, etc., $1,201,522; profit and loss (surplus), $383,161. Total, $22,582,623.

INCREASE OF TELEPHONE STOCK.—The Citizens' Telephone Company of Columbus, Ohio, has filed a certificate with the Secretary of State, increasing the capital stock of the company from $750,000 to $1,250,000. The new issue is to be 6 per cent. preferred stock, upon which dividends are to be paid semi-annually. It is also to be preferred in case of insolvency. John Joyce signed the certificate as president of the company, and Edwin R. Sharp as secretary.

CAMBRIDGE, MASS., ELECTRIC LIGHT.—The Cambridge Electric Light Company makes the following statement for the year ended June 30, 1904:

	1904.	1903.	Inc.	Dec.
Gross	$225,510	$198,062	$27,448	.....
Net	97,979	55,185	42,794	.....
Surplus after charges and div.	19,830	10,431	9,399	.....

DIVIDENDS.—Directors of South Side Elevated Railroad of Chicago have declared the regular quarterly dividend of 1 per cent., payable Sept. 30.

Commercial Intelligence.

THE WEEK IN TRADE.—The general situation is satisfactory. The crop reports are better; the labor situation is improving, and there is a better tone in textile manufacturing circles. The industrial situation is taking on a more hopeful aspect, and railway earnings show slight gains as compared with the corresponding month last year. Recent cuts in finished steel and iron products have created a feeling of uncertainty among buyers, who show an inclination to wait for further developments. Structural materials have, it is stated, also been cut to find a market. An order for 60,000 tons of steel rails is reported to have been placed by the Canadian Pacific Railway on a basis of $22, while orders for as much more have been placed by domestic roads. Domestic quotations are maintained at $28. Copper is slightly easier and the general situation remains very quiet. While exportation is going on at a brisk rate, there seems to be plenty of copper left here, as it is freely offered. The large producers have cut prices in an endeavor to create a demand. The closing prices are 12½c. to 12¾c. for Lake and electrolytic and 12c. to 12½c. for casting stock. The business failures for the week ending August 25 aggregated—according to *Bradstreet's*—185, against 203 the week previous, and 142 the corresponding week last year.

GENERATORS, ETC., FOR PHILADELPHIA WANAMAKER STORE.—Awards have been made this week on the contracts for considerable of the equipment to be installed in the huge electric lighting plant for the new John Wanamaker department store, Philadelphia. This plant will be the largest isolated lighting installation of its description in the country. The initial equipment will have a generating capacity of upward of 3,000 kw. The contract for the generators has been allotted to the Crocker-Wheeler Company, through its Philadelphia offiecs. It calls for four 500-kw. engine type machines, 115 r.p.m., to be direct-connected to cross-compound condensing engines. There will also be six generators of similar type, operating at 115 r.p.m. and to be arranged for double direct-connection to engines. The capacity of these generators will be 175-kw. each. At time of writing, the engine contract, as far as could be ascertained here, was not actually awarded. It is expected that the issue lies between the Allis-Chalmers Company and the Buckeye Engine Company, the latter concern having secured the contract for the engines for the new New York Wanamaker plant. The contract for the wiring of the Philadelphia store will be undertaken by the Philadelphia Electric Equipment Company.

TELEPHONE DISTRIBUTING FRAMES.—The Monroe County Telephone Company, of Sparta, Wis., has recently purchased from Frank B. Cook, of Chicago, one of his well-known type L distributing frames, equipped with No. 44 protector. The board has a capacity of 600 pairs, and is now equipped for 300 pairs. The company expects to make additions in the near future, and it will probably not be long before the capacity of the board will have to be increased. The distributing frame which Mr. Cook originally shipped to the Sabine Valley Telephone Company, at Center, Tex., had a capacity of only 200 lines, but their business increased at such a rapid rate that they were obliged to increase the capacity to 300 lines. One of the features of this distributing frame is that extensions can be made as business demands, and the strips of protectors are also arranged for adding to the capacity in banks of 20 pairs at any time. The Auburn Telephone Company, of Auburn, N. Y., has

recently made an addition to its distributing frame, which was manufactured by Mr. Cook. This addition of 400 lines brings the total capacity up to 2,050.

SOME CROCKER-WHEELER ORDERS.—The Crocker-Wheeler Company, through its New York offices, of which Mr. F. H. De Gress is manager, reports recent receipt of a fine-sized batch of orders for motors, etc. A small-sized lighting set has been requisitioned for by Czarnikow, MacDougall & Company, Limited, of 112 Wall Street, for shipment to Cuba, where it will be used on one of the big plantations. The list of domestic orders includes additional motors for the Jersey City Printing Company's plant; a generating outfit for the laboratories of the Pratt Institute, Brooklyn; several motors to be used for driving Bridgeport safety emery wheel grinders at the Brooklyn Navy Yard; motors 10-hp. and 15-hp. size for the Hebrew Technical Institute, 36 Stuyvesant Street; motors of 25hp. each for the new Procter & Gamble plant at Armourdale, Kansas, and a marine lighting set for the Burlee Dry Dock Company, Port Richmond, S. I.

NEW TELEPHONE SYSTEM FOR MEXICO CITY.—Mexican advices state that Mr. Jose Sitzenstalter, of Mexico City, who is the instructor of Federal printing telegraph operators, has been granted a concession by the Mexican Government which permits of the installation of a new telephone system in the capital of the southern republic. Primarily interested in the Sitzenstalter concession is a Swedish syndicate, of which the well-known firm of L. M. Ericsson, of Stockholm, is a member. About the middle of October a representative of the Swedish syndicate is expected to arrive in Mexico City for the purpose of completing the details for starting the work. The Ericssons are understood to be making arrangements to install other telephone systems on this side of the Atlantic.

AMERICAN TELEPHONE & TELEGRAPH.—The company's instrument statement for July is as follows:

	Mo. ended July 31, '04.	Mo. ended July 31, '03.	Mo. ended July 20, '02.	Mo. ended July 20, '01.
Gross output	80,348	69,194	59,935	56,526
Returned	42,842	44,116	34,054	30,241
Net output	37,500	25,078	25,881	26,285
	Since Dec. 31, '03.	Since Dec. 31, '02.	Since Dec. 20, '01.	Since Dec. 20, '00.
Gross output	672,032	669,258	649,044	526,449
Returned	290,032	279,257	260,321	224,810
Net output	382,000	390,001	388,723	301,639
Total outstanding	4,161,517	3,540,321	2,914,735	2,254,455

EQUIPMENT FOR VERA CRUZ HARBOR.—Considerable electrical equipment is to be installed in connection with the extensive harbor improvements now under way at Vera Cruz, the principal seaport of Mexico. The British contracting firm of S. Pearson & Son, Limited, has the contract. Some idea of the magnitude of the orders to be placed will be gathered when it is stated that upward of $30,000,000 (Mexican currency) has already been expended. Mr. A. E. Worswick, formerly general manager of the Mexico City electric traction system, is the consulting electrical engineer for the Pearson people. His headquarters are in Mexico City.

PHILIPPINES POWER TRANSMISSION.—Advices from Manila state that the harnessing of the Botocan Falls and the Rivers Caliraya and Lomot, in the Province of Laguna, and the Angat River in Bulacan, and the transmission of the current to Manila and vicinity are electrical problems now receiving consideration from the Bureau of Engineering. It is expected that 30,000 hp or more can be generated, a power sufficient to meet the requirements of the traction system (now under construction) as well as the lighting and the mechanical needs of the city for several years.

LIGHT AND POWER FOR LEON, MEXICO.—One of the principal commercial cities in the State of Guanajuato—Leon—is to have an up-to-date American electric lighting and power system. A contract has been entered into by Mr. Oscar Braniff, of Mexico City, with the Guanajuato Electric Power Company to furnish power from its plant located at Zamora on the river Douro. The transmission line at present built to the city of Guanajuato will be carried on to Leon, a distance of 25 miles. In the first instance, Leon will consume 1,000 h.p. for lighting purposes and for use by some of the various manufacturing plants in the vicinity.

ELECTRIC PUMPING EQUIPMENT FOR EAST ORANGE.—Bellman & Sandford, 149 Broadway, New York, have been awarded the contract for the equipment to be installed in the pumping station of the East Orange Water Works, at White Oak Ridge, N. J. The contract calls for a centrifugal pump capable of handling 5,000,000 gallons every twenty-four hours. The pump is to be electrically operated. It will be direct-connected to a vertical motor of 45-hp capacity. The contract also requisitions for a 50-kw generator, direct-connected to a 75-hp cross-compound engine. There will also be a 7-kw generating set, together with switchboard. The Bellman & Sanford bid was $7,190.

THE SPRAGUE ELECTRIC COMPANY reports an excellent business in the electric hoist department. Among recent orders are eight electric hoists for Davis & Thomas Company, Catasauqua, Pa., to be used in handling castings for the new Pennsylvania Railway tunnel under New York City; 13 hoists for the Pennsylvania Railway Company car wheel foundry at Altoona, Pa., and 20 hoists for the new works of the International Steam Pump Company at Harrison, N. J.

ELECTRICAL SUPPLIES IN TRANSVAAL.—A. Vandam & Company have opened showrooms and offices in Hosken's Building, Government Square, Johannesburg, South Africa. This firm is successor to Vandam, Marsh & Company, Ltd., and has warehouse capacity for meeting orders from stock. This English concern makes a specialty also of American apparatus. Its business is said to have attained large proportions.

EQUIPMENT FOR MEXICAN QUARRIES.—Extensive grindstone quarries in the vicinity of Guadalajara, State of Jalisco, Mexico, are about to be exploited, which will insure the purchase of considerable electrical equipment, including material, etc., for an electric railway to be built between Guadalajara and the property—a distance of about 40 miles. Mr. Charles Carroll, of Guadalajara is the prime mover in the project.

EQUIPMENT FOR SAN FELIPE MINES.—The San Felipe mining property near the boundary lines of the States of Jalisco and Tepic, Mexico, and owned by Pennsylvania capitalists, is to be electrically operated. Power will be derived from a plant on the Amajac River for the purpose of mining the reduction works, etc. Col. N. Z. Seitz is general manager of the San Felipe Company.

LIGHTING PLANT FOR MANILA FORT.—An electric lighting plant is to be installed at Fort William McKinley, Manila, P. I. Plans and specifications are now being drawn up. The equipment to be put in will take care of 6,000 16-cp lamps. Alternating current will in all probability be used. The contracts will be placed through the Quartermaster's Department at Washington, D. C.

THE NEW ORLEANS ELECTRIC COMPANY, LIMITED, 616 Commercial Place, New Orleans, is in the market for about 10,600 pounds T. B. W. P. wire, No. 0 B. & S.; 6,100 pounds bare No. 0 and 600 feet No. 0, R. C. wire, to be used on a contract for the power transmission lines of the New Orleans Water and Sewerage Board. Mr. S. Bowling can be addressed.

BLAKE PUMPS FOR PHILIPPINES HARBOR WORK.—J. G. White & Co., 43-49 Exchange Place, New York, who recently secured the contracts for the construction of harbors at Cebu and Iloilo, P. I., have let the contract to the International Steam Pump Company, of 114 Liberty Street, for several Blake pumping equipments for use in connection with the work.

TROLLEY WIRE FOR MEXICO.—The Ansonia (Conn.) Brass & Copper Company has secured a substantial contract for trolley wire, etc., for the Mexico City electric traction system, of which Mr. W. W. Wheatley, formerly general manager of the railroad department of the Public Service Corporation of New Jersey, is manager.

EQUIPMENT FOR NEW NEWPORT HOTEL.—A good-sized lighting plant is to be put in the big hotel to be built at Newport, R. I., by a syndicate, which is represented by Mr. Joseph Myers, of 170 Broadway. Mr. John Lyman Faxon, of Boston, Mass., is the architect. The hotel will cost about $1,000,000.

NEW BOSTON STORE TO TAKE STREET CURRENT.—The new $3,000,000 department store to be built in Boston and leased to Mr. Henry Siegel, will take current from the street. Mr. Harry Alexander, of 20 West Thirty-fourth Street, is the electrical engineer.

MORE EQUIPMENT FOR McKESSON & ROBBINS.—McKesson & Robbins, the wholesale druggists, of 91 Fulton Street, New York, are to rearrange and considerably enlarge their power plant. Mr. Frank Sutton, Tontine Building, is the electrical engineer on the work.

THE KABELFABRIK ACTIEN GESELLSCHAFT of Vienna, Austria, informs us that it furnished the lead covered and aerial cables for the new telephone exchange at Buda-Pest, Hungary, described and illustrated recently in these columns.

TELEPHONE SYSTEM FOR BRAZILIAN RAILROAD.—A contract is about to be placed for the installation of a somewhat extensive telephone system for the Central Railway of Brazil, whose head offices are in Rio de Janeiro.

LIGHTING EQUIPMENT FOR STATEN ISLAND FERRY.—Orders will shortly be placed for lighting equipment for the new Staten Island ferryhouse. Mr. J. J. F. Garigan, 1123 Broadway, New York, is the architect.

THE SOUTH SIDE ELEVATED of Chicago has placed an order with the American Bridge Company for $5,000,000 worth of building material.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Stadtler, 39 S. 10th St., Philadelphia. Next meeting, St. Louis, Sept. 12-17, 1904.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, St. Louis, Sept. 13, 1904.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, Oct. 4, 1904.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago. Next meeting, St. Louis, Mo., Oct. 12 and 13, 1904.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore. Next meeting, New Castle, N. H., Aug. 30 and 31 and Sept. 1, 1904.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Chattanooga, Tenn., third Wednesday in May, 1905.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Montreal, 1905.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col. Next meeting, Colorado Springs, Sept. 21, 22 and 23, 1904.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, D. Fleming, Harrisburg, Pa. Next meeting, New York City, December, 1904.

ELECTRICAL ASSOCIATION OF NORTH DAKOTA. Secretary, S. J. Fuller, Larimore, N. D. Next meeting, Fargo, first week in October, 1904.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, LaSalle, Ill.

INDIANA PUBLIC UTILITIES ASSOCIATION. Secretary, A. M. Barron, South Bend, Ind. Next meeting, Indianapolis, Ind., Oct. 18, 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES OF AMERICA. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago. Next meeting, St. Louis, Sept., 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Pichardt, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, St. Louis, Sept. 13 and 14, 1904.

INTERNATIONAL ELECTRICAL CONGRESS. General secretary, Dr. A. E. Kennelly, Cambridge, Mass. Meeting, St. Louis, Sept. 12-17, 1904.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. M. Coleman, Louisville, Ky.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. S. Porter, Eldora, Ia. Next meeting, Dubuque, Ia., April, 1905.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Des Moines, Ia. Next meeting, second Tuesday in March, 1905.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Next meeting, Lexington, Ky., Oct. 11 and 12, 1904.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, St. Louis, Mo., September 14, 15 and 16, 1904.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Dudley Farrand, Newark, N. J.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, St. Louis, Sept. 12-16, 1904.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, C. J. Miller, Canton, Ohio. Next meeting, Canton, Nov. 18, 1904.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, F. E. Scovill, Austin, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt. Next meeting, Montpelier, Sept. 21 and 22, 1904.

WESTERN SOCIETY OF ENGINEERS, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

General News.

THE TELEPHONE.

DUNWOODY, GA.—The Bell Telephone Company has completed a line from Roswell to Dunwoody.

JACKSONVILLE, ILL.—The Illinois Telephone Company has increased its capitalization from $100,000 to $500,000.

ST. JOSEPH, ILL.—The St. Joseph Telephone Company has been incorporated with a capital stock of $18,000. The incorporators are N. C. Hoyt, O. C. Boggs and others.

MAROA, ILL.—The Maroa Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are J. P. Stoutenborough, J. T. Keats and Elliot James.

BELVIDERE, ILL.—The Boone County Telephone Company has been incorporated with a capital stock of $2500. The incorporators are Fred W. Plane, D. W. Barningham and S. Hicks.

CHICAGO, ILL.—The Cedarville Telephone Company, of Stephenson County, has been incorporated with a capital stock of $7000. The incorporators are S. W. Roberts, S. F. Newhall and H. M. Fisk.

GALESBURG, ILL.—The Dahinda Farmers' Telephone Company has been incorporated with a capital stock of $1400. The incorporators are Samuel Sutherland, Charles Woolsey and J. M. Oberholtzer.

ROCKVILLE, IND.—The Park County Telephone Company, of which A. M. Adams is president, has increased its capital stock to $36,000.

MANNING, IA.—The Manning Telephone Company has been incorporated with a capital stock of $25,000. The incorporators are W. B. Swaney, Philip Zerwas and others.

SIOUX CITY, IA.—An agreement between the new Sioux City Telephone Company and some of the leading independent telephone companies of South Dakota has been concluded whereby the various interested companies are made practically one. The parties in the agreement besides the Sioux City Telephone Company are the new Yankton Telephone Exchange, at Yankton, the Bruce lines, reaching a number of smaller South Dakota points, the Citizens' Exchange, of Sioux Falls, and the Ward lines. A number of smaller independent lines, forming a network over the southwestern portion of South Dakota, are to be taken into the agreement. It is planned by the promoters of the combination to construct lines to Mitchell, Aberdeen, Watertown and Brookings and all of the principal towns east of the Missouri River in South Dakota.

WASHINGTON, KAN.—The Washington Mutual Telephone Company has been incorporated by John King, G. Wertman and others.

GALENA, KAN.—The Southeast Kansas Telephone Association held a meeting here on Aug. 17 for the purpose of harmonizing toll service rates. Agreement was reached upon the various points of difference and all matters were satisfactorily settled. The officers of the organization are: President, G. H. Spangler, Chetopa; vice-president, E. W. Dow, Baxter Springs, and secretary and treasurer, M. L. Robeson.

NORTH PENOBSCOT, ME.—The North Penobscot Telephone Company has been incorporated with a capital stock of $5000. Henry P. Osgood, president.

SOUTH CHINA, ME.—The China Telephone Company has been incorporated with a capital stock of $10,000. W. J. Thomas is president.

DUNDEE, MICH.—The Monroe County Telephone Company has increased its capital stock from $15,000 to $30,000.

CERRO GORDO, MINN.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $20,000.

ST. PAUL, MINN.—It is understood that the Northern Pacific Railway will let contracts soon for telephone systems along its line to be used for train dispatching.

DULUTH, MINN.—The Zenith Telephone Company is now expending between $75,000 and $100,000 in enlarging and improving its plant and adding to its capacity.

ALBERT LEA, MINN.—The Albert Lea Telephone Company will discard the automatic system and install a central energy manual system. Considerable cable work will be done.

MINNEAPOLIS, MINN.—E. H. Moulton, of Minneapolis, president of the Tri-State (Twin City) Telephone Company, has made arrangement for extending the line from Minneapolis to Sioux Falls, South Dakota, and Austin and Albert Lea, Minnesota. It is also planned to build from Austin east to La Crosse, Wisconsin.

CUMBERLAND, MISS.—The Cumberland Telephone Company has secured a franchise for the establishment and operation of a telephone system within the city limits.

DRYDEN, MO.—The Dryden Telephone Company has been incorporated with a capital stock of $1100. The incorporators are J. S. Campbell, L. D. Perry and others.

ARCADIA, MO.—The Arcadia & Drywood Telephone Company has been incorporated with a capital stock of $750.

GREAT FALLS, MONT.—The Cascade County Rural Telephone Company has been organized with a capital stock of $50,000. Those interested are Duncan Cameron, W. K. Foster and John Mainland. The first rural line will be built to Black Butte.

GLASSBORO, N. J.—Pilesgrove Rural Telephone Company has been merged into the People's Rural Telephone Company of New Jersey.

CAMDEN, N. J.—The Delaware & Atlantic Telegraph & Telephone Company has been incorporated with a capital stock of $100,000. The incorporators are W. N. Bethell, James Mitchell, Theodore Spencer, Winfield S. Piersol and H. F. Ettinger.

LYONS, N. Y.—The Wayne-Monroe Telephone Company has increased its capital stock from $30,000 to $100,000.

FAIR HAVEN, N. Y.—The Sterling Telephone Company has been incorporated with a capital stock of $960. The directors are F. B. Phillips, Frank Longley and Herbert Grant.

FRANKLIN, N. C.—The Franklin, N. C., Telephone & Electric Company has been chartered, with a capital of $15,000, by J. S. Trotter, of Franklin, N. C., and others. A local telephone and lighting plant will be established.

HALLSVILLE, OHIO.—The Colerain Telephone Company has been formed by R. D. Robinson and others with $10,500 capital.

DAYTON, OHIO.—The Homer Telephone Company, of which John T. Barlow is president and Jesse C. Reber, secretary, has increased its preferred stock from $1,000,000 to $1,200,000.

IRONTON, OHIO.—A new Bell exchange is being put in at Ironton, the Mt. Vernon system is being completely reconstructed, and a new line is being built from Columbus to Washington C. H.

COLUMBUS, OHIO.—The Franklin County Telephone Company has been incorporated with a capital stock of $150,000. The incorporators are Isaac B. Cameron, Seth L. McMillan, Ralph Reamer, Homer L. Rose and Chas. F. Johnson.

CADIZ, OHIO.—The United States Telephone Company is constructing a line between Cadiz and Uhrichsville. The Cadiz end of it will be operated from the office of the Harrison County Telephone Company, and the new line will be available for the use of the entire Harrison County system.

GENEVA, OHIO.—Homer Hood, of Toledo, has made a formal request of the council for the franchise to construct and operate an up-to-date telephone system in Geneva. While Mr. Hood has applied for the franchise, many of the residents here look upon the proposition as coming from the Bell Company.

COLUMBUS, OHIO.—The Franklin County Telephone Company of Columbus has been incorporated by Isaac B. Cameron, Seth L. McMillen, Ralph Reamer, Homer L. Rose and Charles F. Johnson. The company proposes to operate telephones connecting Westerville, Gahanna, Worthington, Galloway, Groveport, New Albany, Dublin, Black Lick, Brice, Central College, Elmwood, Howden, Pleasant Corners, Pickerington, Lithopolis, Apice and the Girls' Industrial school with Columbus. The Franklin County Telephone Company has been owned and controlled by the Citizens' Telephone Company for some time.

FOSS, OKLA.—The Northwestern Telephone Exchange has been incorporated by S. H. and O. H. James. The capital is $5000.

GUTHRIE, OKLA.—The Northwestern Telephone Exchange, of Foss, has been granted a territorial charter, with $5000 capital stock. The incorporators are S. H. James, Emma, Etta and O. H. James.

BEND, ORE.—The Duschutes Telephone Company has been incorporated with a capital of $3000. The incorporators are P. L. Thompkins, Geo. C. Steinman and W. E. Guerin, Jr.

TOLO, ORE.—The Condor Water & Power Company, of Tolo, proposes to add 6000 horse-power to its plant, and extend its system by the addition of 40 miles of circuit. The company has franchises for the lighting of Medford, Grant's Pass and Antral Point. Mr. C. R. Ray is general manager of the company.

PHILADELPHIA, PA.—The Hollidaysburg Borough Council at Altoona, Pa., has ordered immediate steps to be taken to revoke the franchise of the Bell Telephone Company because of advance in rates.

ST. STEPHENS, S. C.—A charter has been issued to the Berkley Telephone Company. Capital, $1000.

JUNCTION CITY, TEX.—The Junction City Telephone Company has been chartered with a capital stock of $5000.

DALLAS, TEX.—M. T. Sherman, of Joplin, Mo., has a franchise for a new telephone system at Jennings. A franchise has been granted at South McAlester, I. T., for the construction there of a central energy Bell telephone system, estimated to cost $50,000. The Chickasha-Altus Telephone Company will extend its system to Hobart. Charters have been granted to the following named companies for the construction of telephone systems: Lincoln County Rural Company, of Tyron, with $5000 capital; the Southwestern Company, of Frederick, with $5000 capital; the Frederick Telephone Company, of Frederick, with $3500 capital.

WELCH, W. VA.—W. D. Ross has secured a contract from the Lynchburg Water Department to erect a telephone line 25 miles long to the site where it is proposed to secure water for the city. The contract amounts to about $3000.

SHAW, WIS.—The Shaw Telephone Company has been incorporated with a capital stock of $5000. The incorporators are Charles Seguire, Ira Ives and Nels M. Johnson.

CAMBRIA, WIS.—The Cambria Co-operative Telephone Company has been incorporated with a capital stock of $1000. The incorporators are H. W. Thomas, Chris Hecker and E. D. Ford.

BREMERTON, WASH.—The Northwestern Peninsular Telephone & Telegraph Company has been incorporated here with a capital stock of $50,000. The trustees are William D. Calder, S. F. Hoffman and George W. Hoffman.

WALKERVILLE, ONT.—The Ontario Independent Telephone Company has applied to the council of the town of Walkerville for a franchise. As the Bell Telephone franchise there expires in November next, a warm fight is anticipated. The Independent Company is seeking to have a service in Windsor, Walkerville and Sandwich. It will give connections with the co-operative company in Detroit, Mich.

ELECTRIC LIGHT AND POWER.

ANDALUSA, ALA.—The Andalusa Light & Water Company has been incorporated with a capital of $35,000, by John McDavid, W. K. Hyer, Jr., Henry Hyer and Frank Sutter.

ANNISTON, ALA.—The Anniston Electric & Gas Company has been incorporated with a capital of $25,000. Incorporators: Kenneth K. McLaren, W. H. Bradley and Clifford W. Perkins.

ANDALUSIA, ALA.—The Andalusia Light & Water Company has been incorporated with a capital stock of $35,000. The incorporators are John McDavid, W. K. Hyer, Jr., Henry Hyer and Frank Sutter.

HARTFORD, CONN.—Thomas C. Perkins has bought the controlling stock of the Windsor Locks Electric Light Company and intends to enlarge and improve the plant and increase the water power.

DENVER, COL.—The Northern Colorado Light & Power Company has been incorporated with a capital stock of $500,000. The incorporators are Rodney Curtis, Charles M. Hobbs and Loren Curtis.

JACKSONVILLE, FLA.—Supt. R. N. Ellis has been requested to submit an estimate of what extensions will be necessary in the electric lighting, water works and sewer systems to meet the demands of the city for 10 years in the future.

MATTOON, ILL.—The stockholders of the Mattoon Heat, Light & Power Company held their annual meeting on Aug. 9 and elected the following-named officers: P. C. Summerville, president; Louis Katz, vice-president; H. W. Tolle, secretary; L. C. Rose, treasurer, and E. A. Potter, manager.

SEELEYVILLE, IND.—N. B. Stanley has been granted a franchise to establish a plant for electric lighting in this city.

ALEXANDRIA, IND.—The Town Council has awarded the contract to light the city for ten years to the Alexandria Electric Light & Power Company.

AFTON, IA.—The citizens have voted in favor of constructing an electric light plant. A. C. Robinson is Recorder.

BALTIMORE, MD.—Mayor Timanus is having plans prepared for a municipal heating, lighting and power plant in the wharf district, estimated to cost about $150,000. The purpose is to light and heat the Court House, City Hall and other public buildings, illuminate the new piers and markets and furnish power for ships at the piers.

ST. IGNACE, MICH.—The citizens have voted in favor of issuing $15,000 electric light bonds.

HAMMONTON, N. J.—The Hammonton & Egg Harbor City Gas Company has purchased from the Atlantic County Electrical Company the electric lighting plant here. The new owners will merge the lighting and gas plants on West End Avenue and expend $16,000 in building a power-house and installing new machinery.

CLINTON, N. Y.—A charter election will probably soon be held to vote on issuing bonds for the construction of an electric light plant.

SIDNEY, OHIO.—The Citizens' Light, Heat & Power Company has been incorporated with a capital of $150,000.

COLUMBUS, OHIO.—The Ada Water, Heat & Light Company has increased its capital stock from $75,000 to $100,000. C. S. Ames is the president.

COLUMBUS, OHIO.—The contract for the installation of the electric light system, including generators, engines and switchboard, for the new building of the Columbus Savings & Trust Company, has been awarded to the Electric Supply & Construction Company of Columbus, for $30,000.

SISKIYOU, ORE.—The Siskiyou Electric Power Company has completed the installation of its power line through the Little Shasta Valley, thus adding 14 miles to its distributing system in Siskiyou County.

FRANKLIN, PA.—The Franklin Extended Electric Company has been incorporated with a capital of $20,000, by D. W. Klinefelter, O. C. Harris and others.

PITTSBURG, PA.—Wm. Miller & Sons Company, Pittsburg, has secured the contract for the power house and steam-heating and lighting plant for the new Carnegie Institute. The building alone will cost $160,000. The contract for the mechanical equipment of this plant has not been awarded.

MAHANOY CITY, PA.—The charter of the Buck Mountain Light, Heat & Power Company, which was recently chartered by Governor Pennypacker, has been put on record. The company has a capital stock of $10,000. The purpose of the corporation is to supply light, heat and power by electricity to the public in Mahanoy. Harrison Ball. I. A. Seligman and others are interested.

ARLINGTON, TEX.—The Arlington Light & Power Company has filed a charter. The capital stock is $10,000. The incorporators are William Dugan, W. C. Weeks, W. L. Sweet, F. A. Hodd and A. W. Collins.

ROANOKE, VA.—The proposed power company is an assured fact. Mr. Camp, the Florida millionaire, is behind the scheme and work will be commenced at once on the big dam on Roanoke River. The contract for cement has been awarded to the Central Manufacturing Company. The dam will give nearly one thousand horse-power. It is understood that Mr. Camp has acquired nearly all the stock and will be practically owner of the enterprise. He is one of the richest men in Florida, being owner of phosphate beds in that State.

PROSSER FALLS, WASH.—The Prosser Falls Electric Company is contemplating installing electric light and power plants in Mabton and Sunnyside.

OCONOMOWOC, WIS.—The council has passed the ordinance granting a franchise to the Watertown & Oconomowoc Light, Heat & Power Company.

CODY, WYO.—A company financed by Denver and Eastern capitalists will soon undertake the construction of a plant at the falls of the Government dam now being built on the Shoshone River. Power will be generated for a smelter, and will also be transmitted to the mines at Kirwin.

THE ELECTRIC RAILWAY.

DECATUR, ALA.—There is a plan on foot to construct an electric railway from Decatur to Trinity Mountain, seven miles away, where J. L. Echols and others may establish a summer resort.

MARYSVILLE, CAL.—The Northern California Counties Electric Railway & Steamer Line has been organized to build an electric railway to connect Marysville, Oroville and Colusa and to establish a line of steamboats to connect with the electric railway for the handling of freight between valley points and this city. F. E. Emlay, of Oroville, an electrical engineer, who is one of the promoters of the enterprise, says the company has secured water rights that will enable it to develop 2500 horse-power at its power plant on Butte Creek, near Oroville. The electric line is to reach a number of important Sacramento Valley points.

BRISTOL, CONN.—The stockholders of the Bristol & Plainville Tramway Company have voted to raise the capital stock of the company from $150,000 to $250,000.

GENESEO, ILL.—The Kewanee, Cambridge & Geneseo Railway Company, which is to build an electric interurban line from Kewanee to Geneseo, has increased its capital stock from $100,000 to $850,000. This company has been negotiating for the sale of its bonds for some time, and is said to have been successful.

COLUMBUS, IND.—The Columbus Street Railway & Light Company has filed articles of incorporation with the Secretary of State. The capital stock is $100,000. The purpose of the corporation is to take over the present street railway system in the city, and to generate and supply electricity, hot water and steam for commercial purposes. R. F. Gottschalk, president; John W. Crump, vice-president; C. F. Crump, secretary and treasurer.

AUBURN, ME.—The Auburn & Turner Railway Company is being organized in Maine, with a capital of $100,000. The temporary officers have been selected and Edgar S. Hill, of Webster, is acting as treasurer. As soon as possible permanent officers will be elected. The intention of the company is to construct a street railway between Lewiston and Livermore Falls, Me.

WESTWOOD, MASS.—The Norfolk Western Street Railway Company has been sold at auction by order of the United States Circuit Court. Fred S. Gore, of Boston, was the purchaser, his bid being $18,100, the property being subject to a mortgage of $100,000 and interest. The line is 9¾ miles in length.

LIBBY, MONT.—It is reported here that Joseph Plastina, of Spokane, Wash., and F. M. Barrett, a Wisconsin capitalist, are behind a project to build an electric railway from this city to mines in the mining district to the south. Ample water power is available for the operation of a plant.

TYRON, N. C.—There is talk of building an electric railway from here to Mill Spring in the mountains of the western part of the State. Major W. A. Cannon, of Lynn, is interested.

LIMA, OHIO.—Work has been started on building for six sub-stations for the line of the Fort Wayne, Van Wert & Lima Traction Company. Current for this road will be supplied from the St. Mary's power station of the Western Ohio Railway and will be transmitted at 33,000 volts. The Western Ohio station has a large surplus of power, and can handle the 67 miles of additional road without any additions of generating equipment.

PORTLAND, ORE.—A consolidation of the Portland Railway Company and the City & Suburban Railway Company, the two corporations controlling practically all the city lines in Portland, is now assured. A committee consisting of A. L. Mills and Secretary and General Manager C. F. Swigert, of the City & Suburban Company, and Treasurer J. C. Ainsworth and General Manager F. I. Fuller, of the Portland Railway Company, has been appointed to arrange for the consolidation, select the officials of the new company and arrange the other details in the interests of the stockholders. The new company, which will probably be called the Portland & Southern Railway Company, will have a capital stock of at least $4,000,000, that being the combined capitalization of the two merging corporations.

HARRISBURG, PA.—The new owners of the Cumberland Valley Electric Passenger Railway Company, which operates the line between Mechanicsburg and Carlisle, have organized as the Carlisle & Mechanicsburg Street Railway Company, with M. C. Kennedy, of Chambersburg, as president. The road lately became the property of the Valley Traction Company, which already operates lines from Harrisburg to New Cumberland, White Hill, Mechanicsburg, West Fairview and intermediate points, and it is intended to extend it to Carlisle. The officers of the new organization are those of the Valley Traction Company. After Carlisle is reached the company may extend to Chambersburg.

NEW BRAUNFELS, TEX.—The Athens Loan Company, of Athens, Tex., representing Chicago capitalists, is promoting the project of constructing an electric railway between New Braunfels and Gonzales.

PORT ARTHUR, TEX.—George Woodward, of Port Arthur, and associates have obtained a franchise for the construction of an electric railway from Port Arthur to the Port Arthur deep-water docks, a distance of three miles. About one-half mile of this road is finished and in operation. The proposed extension will reach the oil refineries and rice mill.

SALT LAKE CITY, UTAH.—The Salt Lake & Utah Valley Railroad has been acquired through purchase by J. G. Jacobs, of this city, as representative of Eastern capitalists. The road now extends to the southwestern boundary of the city, but the new owners will extend the system as far as the mining town of Bingham, a distance of 21 miles.

MONTREAL, QUE.—The shareholders of the Suburban Tramways & Power Company have elected officers as follows: Hon. L. J. Forget, president; K. W. Blackwell, vice-president; Lieut.-Col. Fred Henshaw, Sir Montagu Allan, Paul Gilbert, directors. W. G. Ross was named general manager, and Patrick Dubee, secretary. This company was organized for the purpose of taking over the Longue Pointe and other projected lines, and is closely identified with the Montreal Street Railway Company.

LEGAL.

ATTACHMENT PLUGS.—In the United States Circuit Court, District of New Jersey, judgment has been rendered and an injunction issued in favor of Pass & Seymour, Inc., for damages and costs, against Duncan Mackenzie's Sons & Company, the proprietors of the Union Porcelain Works, Trenton, N. J., for infringement by the latter of two patents covering the well-known attachment plugs made by Pass & Seymour, Inc., for several years.

TIME STAMPS.—In the Circuit Court of the United States, District of Massachusetts, an opinion was filed by Judge Hale on August 16 in the suit of the Calculagraph Company against John C. Wilson, doing business as the Automatic Time Stamp Company, of Boston, for infringement of two patents numbered 424,291 and 583,320, owned by the Calculagraph Company, in the manufacture and sale by the defendant of the machines styled the "Timometer." The decision holds that the two patents in suit are valid and that claims of both have been infringed by the defendant in his machine. A decree is entered for the complainant for a permanent injunction, and for an accounting with costs.

PERSONAL.

MR. CARL HERING has been appointed a member of the St. Louis World's Fair Electrical Jury.

MR. G. F. ARCHER, electrical engineer, has removed his office to 170 Broadway, New York City.

DR. A. E. KENNELLY has been named a member of the Jury of Awards of the Electrical Department of the St. Louis World's Fair.

MR. JORGE NEWBERY, government delegate of the Argentine Republic to the International Electrical Congress, has arrived at New York.

MR. JAMES R. HOOPER, of Brooklyn, N. Y., has been appointed district superintendent for the Rockland Light & Power Company, Nyack, N. Y.

MR. MIGUEL OTAMENDI, C. E., of Madrid, Spain, a delegate of the Spanish Government to the International Electrical Congress, arrived at New York, Aug. 26.

MR. ANTONIO GONZALEZ, C. E., of Madrid, Spain, arrived in this country Aug. 26 as a delegate of the Spanish Government to the International Electrical Congress.

MR. VAN RENSSELAER LANSINGH, the illuminating engineer of Chicago, is to have supervision of the electrical courses of the Chicago Y. M. C. A. night school the coming season.

MR. BUDD FRANKENFIELD, who recently resigned from the Nernst Lamp Company, has accepted a position in the engineering department of the Bullock Electric & Mfg. Company.

MR. WM. BARCLAY PARSONS, chief engineer of the New York Rapid Transit Commission, returned from Europe on the steamer *Arabic* Aug. 21. He was absent for three months.

GENERAL A. B. SPRAGUE, president of the Worcester, Mass., Electric Light Company, figured conspicuously in the preparations which made the recent G. A. R. encampment in Boston a success.

BELLMAN & SANFORD, of 149 Broadway, New York City, have been awarded the contract for a complete 250-kw capacity plant for the municipality of Burlington, Vt. Mr. W. H. Freedman, of that city, is the consulting electrical engineer for the city.

MR. A. S. CLIFT, electrical engineer with Siemens Bros., Ltd., London, is on a visit home to this country. He went abroad a few years ago to take up designing work for the Siemenses, on their invitation, and is well pleased with his reception and experiences in England.

MR. HENRY FLOY has been appointed by the officers of the Louisiana Purchase Exposition a member of the Jury of Awards pertaining to the Electrical Section. Mr. Floy has left for St. Louis, to take an active part on the jury, which begins its work September 1, and will continue for several weeks.

MR. F. V. HENSHAW, who has for a number of years been active in the management of the engineering and manufacturing departments of the Crocker-Wheeler Company, has resigned from that company and has planned to take a well-earned rest before undertaking new work. In addition to a large share in the work of the engineering department, Mr. Henshaw has had entire charge of the estimating and installation work of the above company and has devoted much study to engineering economies in various manufacturing industries.

MR. E. R. CARICHOFF, M. A., has opened an office at 20 Broad Street, as an expert in electric elevators and motor control, and to engage in the examination of patents and inventions. This gentleman, a member of the American Institute of Electrical Engineers, is well known for his successful engineering work in the elevator field with the Sprague, Otis and General Electric Companies, etc.

MR. C. E. MENDENHALL, of Stone & Webster, Boston, has joined the staff of the Minneapolis General Electric Company, controlled by the firm. Mr. Charles H. Harris, of the Seattle Electric Company, has left the Pacific coast for a month's vacation in the East. Mr. Harris has charge of the underground system in Seattle, having previously been engaged in the same work for the Lowell Electric Light Corporation.

MR. O. H. ENSIGN, of Los Angeles, Cal., has resigned his position as electrical and mechanical engineer with the Edison Electric Company of that city and with which he had been prominently connected for a number of years, to accept a position as consulting engineer with the U. S. Reclamation Service. Mr. Ensign will have supervision of all the electrical and hydraulic power development work of the Reclamation Service and will report directly to Chief Engineer Newell. He will make his headquarters in Los Angeles and will have associated with him H. A. Storrs, electrical engineer of the Reclamation Service.

MR. HENRY W. GOODE.—At a meeting of the directors of the Lewis and Clark corporation at Portland, Ore., Henry W. Goode, director-general of the Lewis and Clark Fair, was elected president, to succeed Harvey W. Scott who is compelled to resign on account of the pressure of private business. He had for a long time been desirous of relinquishing the office, but felt that he could not conscientiously do so until the exposition was on a safe footing. President Goode is one of the keenest business men in the city, abundantly qualified to fill the office to which he has been elected. He is well known in electrical circles as president of the Portland General Electric Company.

MR. G. STANLEY RICHMOND, recently on the engineering staff of the Interborough Company (Subway and Manhattan Division) has opened an office in the Morton Building, Nassau Street, New York, where he will practice as a consulting electrical engineer. Mr. Richmond will make a specialty of investigations and reports on railway ground return and underground distributing systems, and in organizing fuel testing departments for power houses and central stations. Mr. Richmond had charge of the recent investigation conducted by the Virginia Passenger & Power Company of the ground return system of its Richmond roads, and of the improvements which the investigation indicated as necessary to obviate electrolytic troubles.

MR. FRANK B. COOK, the well-known manufacturer of protective apparatus and telephone accessories, is on an extended trip through the West, where he will endeavor to secure a well-earned rest and recuperate from the rush of work incidental to the enormous business he has done this year. Mr. Cook will go to Denver, Los Angeles, San Francisco and other coast points, and return by the way of Salt Lake City, also spending some time in the Black Hills, looking into the progress of the telephone company which he owns there. At Salt Lake City he will spend a short time at the plant of the Utah Telephone Company, where he recently installed a main distributing frame equipped with his protector. The frame has an ultimate capacity of 4100 pairs.

Trade Notes.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., has opened a branch office at 411 Courtland Street, Baltimore, Md., which will be in charge of Mr. H. C. Spaulding, assistant sales manager of the company.

THE ELECTRICAL EQUIPMENT & SUPPLY COMPANY, of Pittsburg, is establishing a record for its success in securing agencies. The latest is the Bryan-Marsh Prismo lamp, which this company now handles.

CHICAGO INSULATED WIRE CAMPANY, 152-154 Lake Street, Chicago, keeps on hand in St. Louis a complete stock of weather-proof wire, annunciator wire, magnet wire, cables and galvanized strand, and is in a position to make prompt shipment from that point.

THE KNICKERBOCKER CONSTRUCTION COMPANY, 15 Cortlandt Street, New York, has been awarded the contract for the installation of 5000 feet of underground cable for the Buffalo, N. Y., fire department. The cable is being manufactured by the American Electrical Works, of Phillipsdale, R. I., and 26 Cortlandt St., New York.

ST. LOUIS FAIR POWER PLANT.—The power plant installed to furnish light and power for the St. Louis Exposition buildings and grounds, and operating the Cascade pumps, will be sold at the close of the Exposition. A complete description of this plant, with illustrations, was given in ELECTRICAL WORLD AND ENGINEER of February 27 last.

THE PERKINS MACHINE COMPANY, which recently moved from South Boston to a larger factory in Warren, Mass., is running its plant night and day in order to execute the large orders which it is receiving. It has also been obliged to add another crane to its equipment, having just installed a large Pawling & Harnischfeger three-motor, electric travelling crane.

EXAMINATION FOR ELECTRICIAN.—An examination of applicants will be held by the United States Civil Service Commission, at Brooklyn, N. Y., on Sept. 21, to fill a vacancy in the position of electrician in the United States Court House and Post Office in that city. The salary is $1000 per annum. Applicants should apply to the secretary of the Board of Examiners at the Custom House, New York, for further information.

"STERLING" SWITCHBOARDS.—The demand upon the Sterling Electric Company, of Lafayette, Ind., for its well-known type of common battery Bell type switchboards is steady and increasing. It has recently installed telephone equipment for the following companies: Johnson City, Ill.; Sebewaing, Mich.; Cerro Gordo, Ill.; Portland, Ind.; Bloomington, Ind.; Winona, Minn.; Charleston, Ill.; Cheboygan, Mich.; Monmouth, Ill.; Shreveport, La.; Bay City, Mich.; Erie, Pa.

KIRKPATRICK & BINDER, of Philadelphia, Pa., on account of increasing business have been compelled to secure larger quarters and have now removed to a new location at No. 38 South Sixth Street, where they intend to exhibit a line of samples of special electrical equipments pertaining more particularly to the heavier range of work, and paying great attention to labor-saving devices and their installation. With larger quarters and better facilities for handling business, they are able to furnish better service, and they invite a call from the trade.

THE STERLING ELECTRIC COMPANY, of Lafayette, Ind., has just completed a large export order for London, England. This company reports a steady growth in export business. The Sterling Company, in addition to its pole boxes and outside terminals, has added to its line of manufacture an iron pole seat, which will meet with favor with construction people. The new telephone catalogue just being distributed by the Sterling Company is a credit to that company and shows its advancement and progress in the instrument line by way of improvement and new designs.

ECALATORS.—Boston's large department store, controlled by the interests of which Henry Siegel is president, is to have the largest equipment of escalators (moving stairways) in the world. The contract has just been signed with the Otis Elevator Company for the installation of ten of these modern appliances. There will be two lines of escalators running between the basement and the fifth floor, five up and five down. By means of special mechanism the descending escalators can be reversed and utilized to carry patrons of the store to the upper floors in the extremely busy season.

THE CALCULAGRAPH COMPANY has recently devised a form of time card for use in printing offices. This card is ruled so that in addition to the elapsed time which is shown by the operation of the instrument a record is kept as to the particular department in which the work is done. The elapsed time is figured either in hours or minutes or in hours and decimal parts and at a fixed rate per hour it is easy to figure the cost of each operation in the printing shop. A letter received from a user of the calculagraph says in one instance that the price of the instrument is saved each month.

MOTORS FOR SEWING MACHINES.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has designed an entirely new motor attachment for household sewing machines. By the use of this device, alternating or direct-current motors can be readily attached to any type of drop-head or stand family sewing machine. Among other advantages, the motor is in all cases placed beneath the table out of the way. Excellent speed regulation of the sewing machine is obtained on all of these outfits. The new Emerson Bulletin No. 3059 describing family sewing machine motors will be sent on request.

THE SUBMERSION OF GENERATORS seems to be a favorite form of amusement this water-soaked year. Some months ago we described the manner in which some Crocker-Wheeler generators had had a thorough-going baptism during the Kansas City floods and had come up smiling. The Cudahy Packing Company, Kansas City, states that it has just had another flood in its plant, similar to the one described before, and that both the 350-kw and 200-kw Crocker-Wheeler generators have come through this unusual test successfully. It was found necessary to re-tape the series fields in the smaller generator, but no other repairs had to be made. Two submersions certainly constitute a severe test for standard and not submarine types of machines.

GENERAL ELECTRIC COMPANY, in Bulletin No. 4382, describes Thomson inclined-coil portable indicating instruments, constructed on the dynamometer principle for voltmeters and wattmeters and on the magnetic wave principle for ammeters. A special form of wattmeters for testing incandescent lamps and other devices of small current capacity has been developed and is known as the lamp inspector's wattmeter, identical in principle and construction with the standard indicating wattmeter. This wattmeter is furnished with two special plugs, an Edison plug with T.-H. adapter, and a Westinghouse plug. The lamp to be tested is inserted in one of the receptacles in the base of the instrument and the proper plug placed in any convenient socket. The instrument measures the consumption of energy in the lamp only and is in no way influenced by the losses in either the potential or the current coils.

3000-KW DIRECT-CURRENT GENERATORS.—In the construction of the Bullock engine-type generator built for the Cincinnati Gas & Electric Company there have been introduced many novel features characteristic of Bullock apparatus, which are dwelt upon at some length in bulletin No. 1029, issued by that company. A special feature is the brush oscillating device employed to prevent the brushes from wearing grooves in the commutator and which provides for slowly carrying the entire brush rigging on trunnions back and forward lengthwise on the commutator. The method of supporting the armature body as adopted by this company is worthy of consideration. A ring is built up from segments of sheet metal, the joints of one layer being midway between the joints of adjacent layers. The several layers are held together by cast iron pieces dove-tailed into the sheet metal with end plates bolted together to keep the laminations in place. The dove-tailed pieces are connected with the arms of a spider. Owing to this construction the spider is relieved from all tensile strain and is called upon only to rotate the rim and keep it central.

GENERATION OF POWER IN PAPER MILLS.—In the manufacture of paper a large amount of steam is used for power as well as for other purposes. Moreover, the demands for steam are not at all constant. The advantages of mechanical draft as an economical factor in the production of steam in paper mills has recently been illustrated in the installation of an induced draft fan driven by a direct-connected vertical engine in the plant of the Chapin & Gould Paper Company, of Huntington, Mass. Previous to the installation of this apparatus it was using three boilers and all the steam they could generate with a high grade of coal. Since the Sturtevant mechanical draft apparatus was installed, the company has been using a much cheaper grade of fuel (which could not be used with chimney draft alone) and now, instead of using three boilers it is only using two and has all the steam it needs, and the sudden demands for steam are easily met. It states that it saved the cost of the apparatus in fuel in six to seven months and regrets that it was not installed before.

SMALL LIGHTING PLANTS.—With the increased use of electric light and of the electric current for fan motors, electric heating, etc., there has gradually grown up a demand for small electric light plants to be installed in individual residences where current from the central station is not available or where there is not a central station. Some plants have been installed for limited supply in small towns on a co-operative basis. This has given rise to the production of small units comprising either a steam engine or a gas engine in addition to the generator. Considerable work is being done in this direction. Noting the progress and development of this work and feeling that there is a field which as yet is undeveloped, the Electrical Equipment & Supply Company, 215½ Fourth Avenue, Pittsburg, Pa., under the energetic management of Mr. J. H. Waugh, its president, has organized a department of its work for the efficient handling of such small plants. It is now prepared to furnish them complete, supplying very efficient machinery of whatever size is desired for the required service. These outfits include a steam engine or a gas engine as may be required. In addition to this, the plans of the company have also been formed to include waterworks plants.

GOULD STORAGE BATTERY COMPANY devotes Bulletin No. 3 to a discussion of the advantages of storage batteries placed at or near the end of feeder lines, or midway between stations, and describes as a typical installation the equipment of the Amherst & Sunderland Electric Street Railway Company, at Amherst, Mass. The daily output of the station is now 1400-kw hours for 861 car miles, or 161 watt-hours per ton mile. Due to the presence of the battery the decreased cost per kw-hour is 3 cents, making a saving on this item alone of $4.20 per day, or $1533 per year.

MEYER GEAR-PUMPING ENGINES for small water-works and elevator service are described in Bulletin L-601, published by the Laidlaw-Dunn-Gordon Company, 114 Liberty Street, New York City. These engines are built in the cross-compound and three-cylinder compound types and with fork frames or rolling-mill frames, and their cost is said to be moderate, compared with Corliss engines, while their steam consumption is hardly more than half of that of the best types of direct-acting compound pumps. When running condensing with ordinary steam pressure they show an average steam consumption of less than 20 lbs. per hp-hour, which would effect a saving, compared with direct-acting compound pumps, of about 130 tons of coal per year for every million gallons daily capacity. These pumping engines are said to have found a wide application in small water-works plants and for circulating brine and hot water, feeding large boiler plants, etc.

STURGESS WATER-WHEEL GOVERNORS.—To meet the demand for a governor which could be installed with a minimum of skill and expense to be used with small wheels, the Sturgess Governor Engineering Company, West Troy, N. Y., has developed a new arrangement of water wheel governors which is self-contained, having the governor and pump both mounted upon the same base, which takes the form of a tank holding oil under pressure for operating the governor. The governor is extremely compact, while accessibility of parts has not been sacrificed to obtain compactness. It is designed so as to shut the gate completely in 1½ seconds and to respond to a speed variation of less than one-half of one per cent., yet they produce no false movements of the gates, and do not oscillate or race at any stage of the load. For large units, the standard type of Sturgess governor in which the tanks and pump are separated from the governor is preferable.

THE C. & C. ELECTRIC COMPANY, 143 Liberty St., New York, has issued Bullein No. 151 describing type S direct-current dynamos and motors which are built in sizes from 1 to 30 horse-power. These machines are characterized by symmetry of outline, compactness and substantiability. Double commutator motors for variable speed work will be supplied when desired. These are used in connection with a series-parallel system of control for operating large cylinder presses, rolling and grinding machines, dock pumps and other machinery requiring very heavy starting torque and a wide range of speed variation. Type S motor is furnished in the vertical style with shaft projecting upward or downward. In this style of machine the top bearing is of metalline, an antifriction composition, while the bottom bearing which carries the weight and thrust of the armature is of a novel type in which the shaft and thrust collars run in a large chamber of oil. The motor rests upon a substantial four-footed casting which contains the oil chamber.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 23, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

767,490. DIRIGIBLE TORPEDO; David Wiley McCaughey, Chicago, Ill. App. filed March 20, 1902. The purpose of this invention is to provide a torpedo with electrically-actuated mechanisms connected with the shore line with but a single insulated wire and arranged and constructed so as to be operated, directed and controlled from the shore by means of an electric current passing through said wire. A plurality of electric motors for operating a movable part or parts is employed in connection with a single line-wire connecting the same with the shore, a step by step switch in the line wire, and electro-magnetic mechanism for operating the switch to supply current to one or both of the motors.

768,039.—TELEPHONE EXCHANGE APPARATUS; James S. Ford, Chicago, Ill. App. filed April 9, 1902.

768,048.—X-RAY TUBE STAND; George R. Hogan, Chicago, Ill. App. filed Nov. 30, 1903. Means are provided by which the circuit through the tube may be instantly reversed without mechanically disconnecting and reconnecting the conductors; means are also provided by which one or more spark gaps are interposed in the working circuit in such a way as to facilitate the reversal of the circuit connections through the tube, and at the same time afford a more convenient means of adjusting the sparking distance.

768,064.—ELECTRIC FURNACE; Carl Gustaf Patrick De Laval, Stockholm, Sweden. App. filed May 8, 1903. (See page 385.)

768,065.—PYROTECHNIC SIGNAL ALARM AND BURNING TORCH; James C. Moore, Philadelphia, Pa. App. filed March 3, 1904. This device is intended to be arranged outside of a building and of being actuated from within the building to give a signal or alarm by a momentary pyrotechnic display and a continued burning of a torch light thereafter.

768,098.—THERMOSTAT; Charles L. Walker, Harrow, Eng. App. filed July 31, 1903. In this device the fluid is forced by the rise of temperature through passages of different areas, so that if the rise of temperature is gradual the displaced fluid is carried off by the small passage, but if the rise is sudden this passage cannot carry off all that which is displaced, and consequently a flow takes place in the larger passage which may be utilized in closing or breaking an electric circuit for sounding an alarm. If the increase of temperature is gradual the flow through the constricted passage is sufficient to prevent the signal being given when the thermostat is used to operate a signaling device.

768,173.—FILAMENT ATTACHMENT FOR ELECTRIC GLOW LAMPS; Ferdinand Fanta, London, Eng. App. filed Nov. 2, 1903. The filament carries tubular metallic tips on its ends, and metallic tips are provided which are secured to the platinum leads protruding from the lamp socket, these tubes extending beyond the platinum leads and having the metallic tips on the filament ends accurately fitting in and secured thereto.

768,175.—CONNECTOR FOR ELECTROCHEMICAL APPARATUS; Oliver P. Fritchie, Denver, Col. App. filed Dec. 28, 1903. (See page 385.)

768,180.—GALVANIC BATTERY; Alex Johannes Jacobson, Hamburg, Ger. App. filed March 19, 1903. (See page 385.)

768,185.—TELEPHONE; John William Kurtz, San Francisco, Cal. App. filed Oct. 17, 1902.

768,196.—LIGHTNING ARRESTER; Charles A. Rolfe, Adrian, Mich. Original app. filed April 21, 1902. Divided and this app. filed Jan. 21, 1903. The invention consists of a ground electrode, line electrodes on opposite sides thereof, a spring supported above the ground electrode and extending on opposite sides to the line electrodes, and softenable material interposed between the spring and the ground electrode so as to hold the same normally out of contact with the line electrode.

768,197.—SWITCH BLOCK; Irving B. Smith, Philadelphia, Pa. App. filed Dec. 3, 1903. The device comprises a supporting plate or backing, a removable contact plate carried thereby, and means independent of the contact plate for securing the block to a support.

768,198.—STEP MOTION FOR CONTROLLER LEVERS; Irving B. Smith, Philadelphia, Pa. App. filed Dec. 9, 1903. The invention consists of a a switch lever adapted to move uninterruptedly and to be brought to rest at desired points and automatic means adapted to adjust the final points of rest of said lever to predetermined positions.

768,199.—RHEOSTAT; Irving B. Smith, Philadelphia, Pa. App. filed Dec. 9, 1903. The rheostat comprises a supporting plate of insulating material provided upon one of its faces with a plurality of radial grooves, a plurality of switch segments mounted on said plate and each provided with a flange or tongue adapted to engage one of said grooves, means for preventing the displacement of said segments, and a plurality of resistance elements connected to said segments.

768,204.—APPARATUS FOR MOVING OR SHIFTING RAILWAY SWITCHES; Louis H. Thullen, Edgewood, Pa. App. filed Oct. 7, 1903. In connection with the usual switch rails and the motor for operating them, a ball-bearing nut is used connected with the switch rails, and an electric clutch between the motor and the nut.

768,214.—ELECTRIC SWITCH AND CIRCUIT BREAKER; Charles E. Carpenter, New York, N. Y. App. filed Jan. 16, 1904. This device is designed for the emergency interruption of motor armature circuits. The same is combined with a hand-operated motor switch by which the motor is started, controlled and stopped in such manner that upon the operation of the circuit breaker from any cause it will not again close until the starting switch has been restored to its starting or initial position.

768,227.—ELECTRIC SWITCH AND CIRCUIT BREAKER; Albert J. Horton, White Plains, N. Y. App. filed Jan. 16, 1904. This device has the same purpose as that of the preceding patent, the invention consisting of details of construction.

768,242.—ROSETTE; Albert P. Seymour, Syracuse, N. Y. App. filed April 27, 1904. The base or block is formed to receive the ends of two wire tubes which are arranged to insulate the wires better by protruding from the wall or ceiling, and a cap is provided which entirely covers the block and has means for securing it in position.

768,245.—TROLLEY; Francis C. Sullivan, McKeesport, Pa., and Louis S. Harris, Pittsburg, Pa. App. filed July 22, 1903. A hood is supported on the shaft of the trolley wheel and extends around said wheel. The said hood is made in two parts pivoted so as to swing outwardly and inwardly and carries rollers, which, when the trolley wheel is in place, are located above the conductor, the trolley cord being adapted to open the said hood.

768,260.—AUTOMATIC BRAKE AND TAKE-UP DEVICE FOR TROLLEY CORDS; Edward H. Amet, Waukegan, Ill. App. filed June 6, 1904. Details.

768,262.—CONTROLLER; Harvey D. Bachman, South Bethlehem, Pa. App. filed May 31, 1904. Details.

768,272.—PARTY-LINE TELEPHONE SYSTEM; Thomas C. Drake, Malta, Ohio. App. filed Nov. 9, 1903.

768,288.—INTERRUPTER; Edwin W. Kelly, Philadelphia, Pa. App. filed March 28, 1904. The invention is designed for interrupting the circuit of the primary winding of a Ruhmkorff or induction coil, and consists of a practically closed magnetic-circuit self-starting interrupter, whose exciting coil may be included in the circuit to be interrupted, or in an independent circuit, in which latter case the moving element of the interrupter is caused to break two independent circuits, one of them including the exciting coil of the interrupter and the other including the primary of the induction coil.

768,301.—WIRELESS ELECTRIC SIGNALING; Michael I. Pupin, New York, N. Y. App. filed June 13, 1903.

768,318.—RAIL BOND; Edward G. Thomas, Waltham, Mass. App. filed March 19, 1903. The bond comprises a flexible portion provided with attaching strips extending laterally beyond one side of the bond proper, and having flat top faces which extend to the edges of said strips, the extended portions of the strips being flexible and inelastic.

768,325.—TROLLEY RESTORER; Edward L. Callahan, Clifton N. J. App. filed Nov. 6, 1903. The means for restoring the trolley to the feed wire is operable from the front of the car.

768,332.—CONTACT CLAMP FOR CARBON RHEOSTATS; Carl W. Larson, Schenectady, N. Y. App. filed Sept. 4, 1902. In connection with a base having a hole therethrough, a self-aligning clamp for an electric conductor is provided, which consists of a sleeve having a convex surface on one side bearing against the base, and a shank extending laterally from the convex side through the hole in the base

768,334.—BREAKER FOR ELECTRIC CIRCUITS; William J. Lloyd and Gilbert Wright, Pittsfield, Mass. App. filed July 8, 1902. Renewed Jan. 23, 1904. Means are provided for connecting and disconnecting the terminal contacts, one of said contacts comprising a magnet coil formed of two turns of metal and providing an opening for a stationary core and also an opening for a movable core, said coil passing once around each core.

768,337.—ALTERNATING-CURRENT MOTOR; Maurice Milch, Schenectady, N. Y. App. filed Dec. 21, 1903.

768,344.—MEANS FOR CONTROLLING ELECTRIC METERS; William H. Pratt, Lynn, Mass. App. filed Jan. 20, 1903.

768,350.—ELECTROMAGNETIC SWITCH AND SIGNAL; Samuel B. Stewart, Jr., Schenectady, N. Y. App. filed May 20, 1902. The invention resides in an arrangement of signals in connection with the electro-magnetic switch, which signals serve to show when the sectional working conductor of a railway system is alive or energized. A signal or semaphore is provided which is mechanically connected with the switch and which is actuated in one direction when the switch is opened and in the opposite direction when

the switch is closed, and there is also provided an electric signal which is connected in shunt to the switch-actuating coil.

768,351.—ELECTRIC CUT-OUT; Julius C. Tournier, Schenectady, N. Y. App. filed Jan. 21, 1901. Details.

768,357.—ELECTRIC TRACK BRAKE; Fred B. Corey, Schenectady, N. Y. App. filed Sept. 27, 1902. One of the purposes of this invention is to insure the disconnection of the brake from the track when the motor is energized to start the car, and the invention consists of a car with its propelling motors and a track brake thereon, the latter having a brake shoe, a solenoid for lifting said shoe, and circuit connections by which said solenoid is energized by motor-current derived from the circuit of a motor which is in circuit whenever power is supplied to the car.

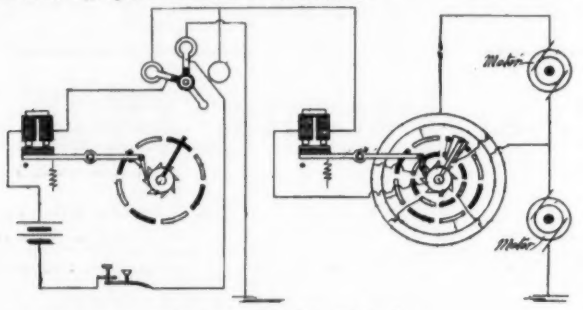
768,372.—ELECTRIC BATTERY; Pierre Joseph Kamperdyk, New York, N. Y. App. filed Oct. 14, 1903. (See page 385.)

768,411.—BLOCK-SIGNAL AND TRACK SWITCH OPERATING DEVICE; Charles R. Van Trump, Wilmington, Del. App. filed April 3, 1904. The purpose of this invention is to provide a signal system wherein as a car enters any block, electrically-operated signals at each end of the block and under the control of the motorman within the moving car, will be displayed or switches operated, and as the car leaves the block from either direction the signals and switches will be restored to their normal positions.

768,467.—CONSTANT-CURRENT SERIES MOTOR; Maurice Leblanc, Paris, France. App. filed Feb. 26, 1903.

768,468.—METHOD OF LIMITING THE SPEED OF CONSTANT-CURRENT SERIES MOTORS; Maurice Leblanc, Paris, France. App. filed Feb. 26, 1903.

768,474.—ELECTRIC SNAP SWITCH; Norman Marshall, Newton, Mass. App. filed Dec. 24, 1900. Details of construction.

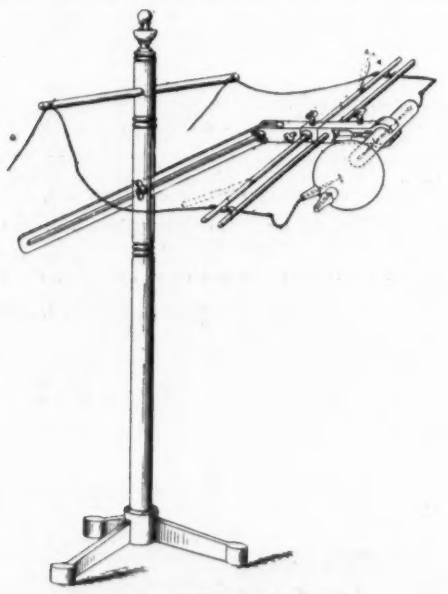


767,490. Dirigible Torpedo.

768,479.—INCANDESCENT ELECTRIC LAMP; Dennis J. O'Brien, San Francisco, Cal. App. filed May 25, 1903. The invention resides in anchors for a longitudinally disposed, centrally located filament in a glass tube or receptacle, the inner ends of the anchors extending in alignment with and secured to the ends of the filament, the outer ends of the anchors protruding exteriorily of the tube, and means engaging the outer ends of the anchors, and connected with a source of electrical energy, the terminal ends of the anchors within the tube extending transversely to the filament and the walls of the tube.

768,480.—SAFETY GUARD; Wilson K. Page, Olean, N. Y. App. filed March 23, 1904. The invention is designed as a safety guard for trolley wires at railroad crossings, and consists of a guard having an open-work body or conducting portion, and trolley wire hangers carried by the crest thereof.

768,487.—FUSE LINK; Edward L. Simons, Aldan, Pa. App. filed Sept. 11, 1903. The purpose of this invention is to provide a fuse link which can be mutilated so as to adapt it for use with currents of widely-varying amperage. The link is constructed from a flat piece of metal, the surface of which is

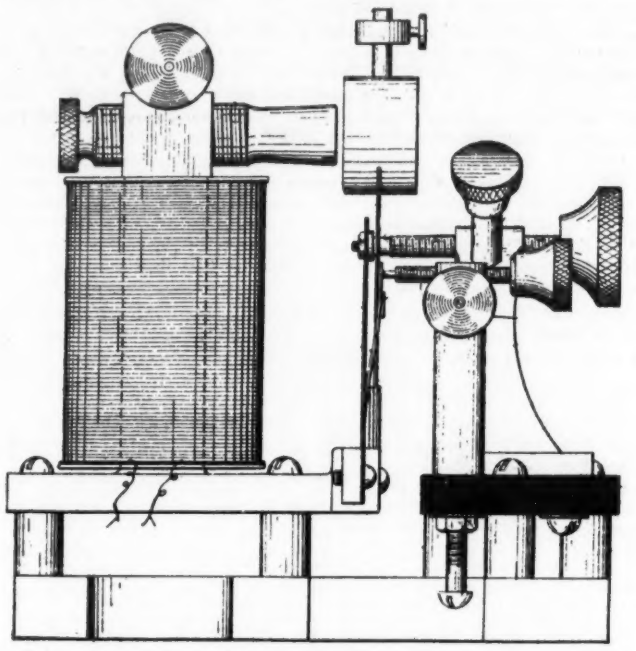


768,048. X-Ray Tube Stand.

divided by imperforate lines into sections each of which will carry a current of known amperage.

768,502.—AUTOMATIC TRAIN SIGNALING AND RECORDING SYSTEM; Frank R. Wood and Daniel F. Shamberger, Sparrows Point, Md. App. filed Aug. 24, 1903. This invention is designed for the purpose of recording at a central station the exact time a certain train passes a certain point or station, together with the train number and the number of the station passed by the train. The same includes a transmitter box having a plurality of number wheels corresponding to the given number of trains and located at a predetermined point or station along the line, the corresponding number wheels of each transmitter being connected in series with each other, and with an electrically operated time stamp and recording mechanism.

768,511.—CONTACT DEVICE FOR ELECTRIC CLOCKS; Ragnar Carlstedt, of Rallsa, Sweden, and Bernhard Gustafson, of Stockholm, Sweden. App. filed Nov. 19, 1903. The invention consists of an electro-magnet, its armature, a swinging contact piece forming one of the terminals of the circuit of said magnet and swung by said armature, a second arm-like contact piece forming the other terminal of the magnet circuit, the second contact piece being actuated in one direction by the first contact piece and provided with a non-conducting piece for breaking the circuit, and retarding means connected with the second contact piece to prevent it from following the other contact piece when the circuit is broken.



768,288. Interrupter.

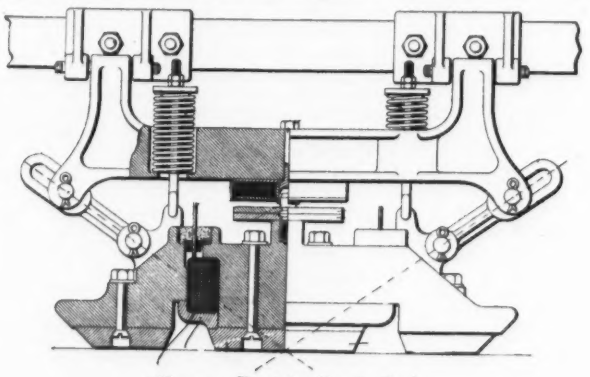
768,545.—ELECTRIC CONDUIT BOX; Dennis Shea, Chicago, Ill. App. filed Aug. 20, 1903. The conduit box comprises a base plate, a wall piece and fastening devices securing them together, consisting of flexible strips having their end portions passed through openings in the base, and bent reversely to bear on the wall piece.

768,549.—ELECTRO-MAGNETIC SWITCH; Samuel B. Stewart, Jr., Schenectady, N. Y. Original app. filed May 20, 1902. Divided and this app. filed Feb. 14, 1903. The switch is designed for handling heavy currents quickly and efficiently and with less injury to the working parts of the switch than is usual. The switch comprises a solenoid, a core for the solenoid carrying main and auxiliary contact makers adapted to engage fixed contacts, a blow-out magnet for each fixed contact having its poles embracing said fixed contacts, and insulating chutes along which the arcs which tend to form between the movable contact makers and the fixed contacts are projected by the blow-out magnets.

768,557.—ELECTRICITY METER; Arthur Blanchet, Paris, France. App. filed March 27, 1902. The invention resides in a motor meter of the induction type comprising coils in a shunt circuit having a large self-induction, a transformer, the primary circuit of which is traversed by the main current, coils included in the secondary circuit of said transformer, a movable armature in the magnetic field of magnetism induced by said coils and of the shunt circuit coils, and means for deviating a fraction of the magnetic flux and thereby producing a symmetry.

768,558.—ELECTRICAL SELECTING OR INDIVIDUALIZING INSTRUMENT; William S. Burnett, Milwaukee, Wis. App. filed Aug. 26, 1901.

768,566.—ELECTRIC CONTROLLER; Miner S. Horton, Rochester, N. Y. App. filed June 4, 1904. The controller belongs to that class in which the speed of the motor is made use of, through a centrifugal governor carried thereby, to gradually cut out resistance in series with the armature as the speed of the motor increases until at nearly the normal speed of the motor for the potential impressed all of the resistance is cut out by the action of the



768,357. Electric Track Brake.

governor. Means are provided for permitting the contact arm of the rheostat to return to that point in its travel where the maximum resistance is cut into circuit with the armature of the motor immediately upon an opening of the field and armature circuits of the motor.

768,567.—SUBMARINE SIGNALING; Arthur J. Mundy, Boston, Mass. App. filed April 23, 1902.

768,568.—SOUND TRANSMITTER AND RECEIVER; Arthur J. Mundy, Boston, Mass. App. filed April 23, 1902.

768,569.—TELEPHONE-TRANSMITTER; Arthur J. Mundy, Boston, Mass. App. filed April 23, 1902.

768,570.—SOUND TRANSMITTER AND RECEIVER; Arthur J. Mundy, Boston, Mass. App. filed April 23, 1902.

768,571.—SOUND TRANSMITTER AND RECEIVER; Arthur J. Mundy, Boston, Mass. App. filed April 23, 1902.

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POSITION WANTED.—By a man experienced in central station management and operation. Address, No. 1596, care Electrical World and Engineer, New York.

POSITION WANTED.—By a skilled workman, expert in winding armatures and repairing generators, fields, commutators, etc.; electric road preferred; also understand the care of electrical apparatus; best of references; married. Address No. 1616, care Electrical World and Engineer, New York.

POSITION WANTED.—By young man with executive ability, as chief draughtsman or assistant to consulting engineer; technically educated, practical experience; thorough knowledge of switchboard work in general; specialty, design of apparatus a. c. and d. c.; New York City or vicinity preferred. Address No. 1615, care Electrical World and Engineer, New York.

POSITION WANTED.—By a first-class armature winder in factory, repair shop or car barn; 10 years' experience in New England shops; 27 years old and married; A1 references as to character and ability. Address No. 1617, care Electrical World and Engineer, New York.

POSITION WANTED.—By electrical engineer; good designer A. C. and D. C. machinery; practical and theoretical experience; made improvements in A. C. machinery; has been connected with large companies. Address No. 1618, care Electrical World and Engineer, New York.

POSITION WANTED.—By electrical engineer, Berlin University; 6 years' experience testing and engineering department; expert designer of dynamos and motors. Address Draughtsman, care Schneider, 125 Waverly Place, New York.

POSITION WANTED.—By a young technical college graduate; mechanical and electrical engineer; some practical experience in drafting and in electrical work. Address No. 1619, care Electrical World and Engineer, New York.

WANTED

YOU, who are troubled with sparking and cutting of commutators, to use

GALES COMMUTATOR COMPOUND. ELECTRICIAN FOR USE

It will put that high gloss on the commutator you have so long sought.

For Sale by all Supply Houses.

The only article that will PREVENT SPARKING. Will keep the commutator in good conditon and PREVENT CUTTING.

ABSOLUTELY WILL NOT GUM THE BRUSHES . .

K. McLENNAN & CO.

Sole Manufacturers (3)

SAMPLE STICK SENT FREE Room 411,130 Dearborn St., CHICAGO, ILL.

IF YOU WANT AN ARTICLE THAT WILL REPEAT ITSELF.

TRY U. S. METAL POLISH

FOR POLISHING ALL KINDS OF METALS.

Sold by Dealers. Samples Free.

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SEND US YOUR INQUIRIES

McGRAW PUBLISHING COMPANY

Book Department, 114 LIBERTY ST., NEW YORK

POSITION WANTED.—By a young man (26) as traveling salesman; would prefer to handle electrical machinery, bare and insulated wires and cables or some good electrical specialty; graduate and eight years' experience in electrical field; willing to travel abroad. Address No. 1620, care Electrical World and Engineer, New York.

POSITION WANTED.—As manager or superintendent of central station or light and water works, by technical man; ten years' experience; interior wiring, central station construction, operation, management; close buyer; economical operator; good solicitor; associate member A. I. E. E.; age 34; excellent habits; energetic; married; good reference. Address No. 1621, care Electrical World and Engineer, New York.

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A well-known expert in interurban railways, lighting and power transmission, is looking for an opportunity to develop a good property. Will take moderate salary and interest in results. Highest recommendations. Address No. 1606, care Electrical World and Engineer, New York.

HELP WANTED.

WANTED

A firm of engineers with good trade connection is open to represent in England a first-class electrical or general engineering firm. Cairns & Co., 91 Queen Victoria Street, London, England.

A POSITION IS OPEN

Do you know where it is? We do. We have openings for high-grade men of all kinds — Executive, Technical, Clerical — paying from $1,000 to $10,000 a year. High grade exclusively. Write for plan and booklet. (4)

HAPGOODS (Inc.)
Suite 511, 309 Broadway, New York.

If you do not know who makes what you want to buy, consult the advertising pages of ELECTRICAL WORLD AND ENGINEER.

FOR SALE

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing complete list of apparatus with NET PRICES. All machines fully guaranteed and every machine listed actually in stock at our warehouses.

ALTERNATORS—60 CYCLES

	Lt.	
2	300	Westinghouse, 15-K.W.
1	500	Wood, 25-K.W.
1	900	West., 45-K.W., 2 phase.
2	1200	West., 60-K.W.
1	1500	Warren-Medberry, 75-K.W.
1	1500	West., 75-K.W.
1	1500	West., 75-K.W., 2 ph., 2200 v., d. c. to 14x14 Gates 4-valve aut. engine.
1	1500	Wood, 75-K.W.
1	2400	Gen. Elec., 120-K.W., 3 ph.
2	3000	Warren, 150-K.W.
1	7200	Gen. Elec., 360-K.W., 3 ph.

ALTERNATORS—125-133 CYCLES

	Lt.	
1	650	Wood, 33-K.W.
1	750	West., 37½-K.W.
1	750	Wood, 37½-K.W.
1	900	Warren-Medberry, 45-K.W.
1	1000	Wood, 50-K.W.
2	1200	Gen. Elec., 60-K.W.
1	1500	Stanley, inductor, 75-K.W.
1	2400	Gen. Elec., 120-K.W., A 120.
2	2400	Gen. Elec., 120-K.W., A.S.120.
2	3000	Stanley inductor, 150-K.W.
1	4000	Westinghouse, 240-K.W.

110 TO 125 VOLT GENERATORS (COMPOUND.)

DIRECT CURRENT.

	Lt.	
2	35	Hobart, Multipolar.
1	45	Lundell.
3	45	Westinghouse, Multipolar.
1	50	Crocker-Wheeler.
2	50	Northern, Multipolar.
1	50	Westinghouse, Multipolar.
2	60	Hobart, Multipolar.
1	80	Fort Wayne, Multipolar.
1	80	Crocker-Wheeler.
1	80	Riker, Multipolar.
1	80	Perrett, Multipolar.
1	100	Card, Multipolar.
2	110	Commercial, Multipolar.
1	150	Edison.
1	150	Eddy, Multipolar.
1	150	Western Elec., Multipolar.
1	150	General Electric, Multipolar.
1	160	Triumph, Multipolar.
1	165	Am. Engine Co., Multipolar.
1	210	Edison.
1	210	Phoenix, Multipolar.
1	210	Eddy, Multipolar.
1	225	Card, Multipolar.
1	260	Commercial, Multipolar.
1	300	Phoenix, Multipolar.
1	300	Perritt, Multipolar.
1	300	Ahlms-Edwards, Multipolar.
2	300	Gen. Electric, Multipolar.
1	300	Western Elec., Multipolar.
2	350	Edison, 20-K.W.
2	350	C. & C., Multipolar.
1	400	Northern, Multipolar.
1	400	Crocker-Wheeler, Multipolar.
2	400	Westinghouse, Multipolar.
2	450	Edison, 25-K.W.
2	450	Commercial, Multipolar.
1	450	Quaker City, Multipolar.
1	450	Triumph, Multipolar.
2	450	Sprague-Lundell, Multipolar.
1	450	Eddy, Multipolar.
1	450	Gen. Electric, Multipolar.
1	450	Western Elec., Multipolar.
1	540	Edison, 30-K.W.
1	540	C. & C., 30-K.W.
1	540	Elwell-Parker, Multipolar.
2	540	Gen. Elec., Multipolar.
3	600	Card, Multipolar.
1	650	Milwaukee, Multipolar.
1	650	Westinghouse, Multipolar.
1	650	Westinghouse, Multipolar, 35-K.W., engine type, direct connected to 10x10 enclosed self-oiling Buffalo Forge engine.
2	700	Commercial, Multipolar.
1	700	Card, Multipolar.
1	700	Crocker-Wheeler, Multipolar.
1	900	Wagner, Multipolar, comp.
1	1000	Edison, 60-K.W.
1	1000	Gen. Elec., 6 pole, comp., direct connected to 12x13 Weston automatic engine, 60-K.W.
1	1100	Triumph, Multipolar.
1	1300	Card, Multipolar.
1	1350	Waddel-Entz, 80-K.W., d. c. to Armington & Sims 15½x14 engine.
1	1350	Ft. Wayne, comp., direct connected to 13x14 Buckeye vertical engine, 80-K.W.
2	1350	Gen. Elec., Multipolar, 6 pole shunt, direct connected to Ames tandem comp. 11x17x12 automatic engine.
2	1800	Edison, 100-K.W.
1	1800	Western Electric, Multipolar, comp., 6 pole, 100-K.W.
1	2200	Western Electric, Multipolar, 125-K.W., 6 pole.
2	2500	Western Electric, Multipolar, comp., 150-K.W., direct connected to 16x18 McEwen engine.

220 TO 250 VOLTS COMPOUND GENERATORS.

	K.W.	
1	7½	Holtzer-Cabot.
1	9	New England, Multipolar.
2	10	T.-H.
1	12	Western Elec., Multipolar.
1	17½	Kester.
1	17½	Eddy.
1	20	Western Electric.
1	20	Keystone, Multipolar.
1	20	Eddy, Multipolar.
2	20	Western Elec., Multipolar.
2	30	C. & C.
1	40	C. & C., Multipolar.
1	40	Eddy, Multipolar.
1	45	Edison.
1	45	Am. Engine Co., Multipolar.
1	45	Western Elec., Multipolar.
1	45	C. & C., Multipolar.
1	45	Gen. Elec., Multipolar.
1	50	C. & C.
1	50	Commercial, Multipolar.
1	50	Maine, Multipolar.
1	55	Fuller, Multipolar.
1	55	Eddy, Multipolar.
1	60	Northern, Multipolar.
1	75	Siemens & Halske, Churchward type, Multipolar, direct connected to 14x14 Ideal engine.
1	80	C. & C.
1	100	Commercial, Multipolar.
1	125	Eddy, Multipolar.
1	150	National, Multipolar.
1	200	Eddy, Multipolar.
1	200	Westinghouse, Multipolar.
1	250	Western Elec., 6 pole.
1	300	Western Elec., Multipolar

500 TO 550 VOLT COMPOUND GENERATORS.

	K.W.	
1	60	Edison.
1	62	T-H.
1	75	Akron, 6 pole.
2	75	General Electric.
1	100	Siemens & Halske, 4 pole.
2	100	Edison.
1	100	Gen. Elec.
2	120	Westinghouse.
1	200	Thompson-Ryan.
1	200	General Electric.

MODERN ELECTRICAL MACHINERY FOR SALE.

DIRECT-CONNECTED UNITS

Dynamo	Engine
75-K.W.	Siemens-Halske.
50-K.W.	220 V. American Ball.
42-K.W.	220 V. Westinghouse, Alfrey.
30-K.W.	500 Gen. Elec. Arm. Sims.
50-K.W.	110 V. Eddy, Ames.
37-K.W.	110 V. West., Erie Ball.
8-K.W.	110 V. Crocker-Wheeler, Case.

110 VOLTS DIRECT CURRENT
Dynamos or Motors

85-K.W. General Electric.
45-K.W. General Electric.
25-K.W. C. & C.
15-K.W. Eddy, M. P.
7½-H.P. Gen. Elec., Type C E.
5-H.P. Gen. Elec. Type C E.
3-H.P. Gen. Elec. Type C E.
2-K.W. Westinghouse.
1-H.P. C. & C.

220 VOLTS DIRECT CURRENT
Dynamos or Motors

75-K.W. Westinghouse.
55-K.W. Gen. Elec., M. P.
40-K.W. Crocker-Wheeler.
45-K.W. Edison.
20-H.P. Card.
15-H.P. Sprague, M. P.
10-H.P. General Electric.
10-H.P. Sprague.
7½-H.P. Edison.
5-H.P. Diehl.
2-H.P. Diehl.
1-H.P. Sprague.

500 VOLTS DIRECT CURRENT

75-K.W. Westinghouse, M. P.
15-H.P. Westinghouse, M. P.
1-H.P. Westinghouse, M. P.

ALTERNATING INDUCTION MOTORS

2 Phase, 60 Cycles, 220 Volts

40-H.P. Type C Westinghouse.
30-H.P. Type C Westinghouse.
15-H.P. Type C Westinghouse.
10-H.P. Type C Westinghouse.
7½-H.P. Type C Westinghouse.
3-H.P. Westinghouse.
2-H.P. General Elec.
1-H.P. Westinghouse.
½-H.P. General Elec., 220 or 110 v.

2 Phase, 440 Volts, 60 Cycles

100-H.P. Westinghouse.
40-H.P. Westinghouse.
30-H.P. Westinghouse.
15-H.P. Westinghouse.
10-H.P. Westinghouse.
7½-H.P. Westinghouse.
3-H.P. Westinghouse.
1-H.P. Westinghouse.

3 Phase, 60 Cycles

5-H.P. Gen. Elec., 220 v.
5-H.P. Gen. Elec., 110 v.
3-H.P. Westinghouse, 110 or 220 v.
2-H.P. Gen. Elec., 220 v.
2-H.P. Westinghouse, 220 or 110 v.

1 Phase, 60 Cycles

5-H.P. General Electric.
3-H.P. Wagner.
1-H.P. Wagner.
½-H.P. Wagner.
½-H.P. Gen. Elec.

1 Phase, 125 Cycles

20-H.P. Wagner.
10-H.P. Wagner.
¼-H.P. Emerson.

Large stock of small motors, auto-starters, starting boxes, rheostats, switchboards, voltmeters, ammeters, etc.

I BUY, RENT AND INSTALL.—GEORGE BENDER, 137 CENTRE STREET, NEW YORK.

CRESCENT COMPANY CHICAGO

TIME

The time when an electrician should buy

CRESCENT Soldering Sticks and CRESCENT SOLDERING PASTE

is the time he comes to realize that the old method of using salt or acid is slow, unhandy and generally unsatisfactory.

It is time when he learns that by using them he can save *Time*, Trouble and Expense.

The time to send for a sample is *Now*.

For sale by all supply houses.

THE CRESCENT COMPANY, CHICAGO, ILL.

BARGAINS

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing NET prices—all machines fully guaranteed and actually in stock.

ARC DYNAMOS.

	Lt.	C.P.	
1	35	2000	T.-H., L D 2 ball.
1	50	1200	T.-H., L D 12, new ball.
2	50	2000	T.-H., M. D 2, 8-o., ring.
1	75	1200	T.-H., M D 12 8-o.
1	75	1200	Wood.
1	125	1200	Excelsior.

220 TO 250 VOLT MOTORS.

	H.P.	DIRECT CURRENT.
1	1	General Electric, type I B.
1	2	Lundell.
1	2½	Riker.
1	3	C. & C.
1	3	Bernard, Multipolar.
1	3	Gibbs, Multipolar.
1	3	Lundell.
3	3	Western Electric, Multipolar.
3	3	Westinghouse, Multipolar.
1	3½	Eddy, Multipolar.
1	4	Commercial, Multipolar.
2	5	Gibbs, Multipolar.
3	5	Hobart, Multipolar.
5	5	Western Electric, Multipolar.
1	5	Eddy, Multipolar.
3	5	Belknap, Multipolar.
2	5	Crocker-Wheeler special printing press motors, direct con.
1	6½	Jenney, Multipolar, back geared.
1	7½	Edison.
2	7½	Western Electric, Multipolar.
1	7½	Milwaukee, Multipolar, series.
1	8	Holtzer-Cabot.
1	8	Crocker-Wheeler, series.
1	8	Maine, Multipolar.
1	10	Standard, Multipolar.
1	10	C. & C., Multipolar.
1	10	Keystone, Multipolar.
1	10	Western Electric, Multipolar.
2	10	Westinghouse, Multipolar.
3	10	Bernard, Multipolar.
1	15	Keystone, Multipolar.
1	15	New England, Multipolar.
1	15	Western Electric, Multipolar.
1	18	Edison, 15-K.W.
1	20	Eddy.
1	20	Kester.
2	25	Edison.
1	25	Western Electric.
1	25	Keystone, Multipolar.
1	25	Eddy, Multipolar.
1	25	Western Electric, Multipolar.
2	40	C. & C.
1	40	Sprague-Lundell, Multipolar.
1	50	C. & C., Multipolar.

	H.P.	
1	50	Eddy, Multipolar.
1	50	Am. Engine Co., Multipolar.
1	60	C. & C.
1	60	Edison.
1	60	Commercial, Multipolar.
1	60	C. & C., Multipolar.
1	60	Maine, Multipolar.
1	60	Western Electric, Multipolar.
1	60	General Electric, Multipolar.
1	65	Eddy, Multipolar.
1	70	Fuller, Multipolar.
1	75	Northern, Multipolar.
1	85	Western Electric.
1	100	C. & C.
1	125	Edison.
1	135	Commercial, Multipolar.
1	150	Eddy, Multipolar.
2	200	National, Multipolar.

500 TO 550 VOLT MOTORS.

	H.P.	
1	1	General Electric.
2	1½	Northern, series.
2	1½	Crocker-Wheeler.
1	2½	New England.
1	3	C. & C.
1	3	General Electric.
1	3	Jenney, Multipolar.
1	3½	Westinghouse, Multipolar.
1	4	Edison.
1	4	Bernard, Multipolar.
1	5	Fort Wayne.
2	5	Triumph, Multipolar.
3	5	Crocker-Wheeler.
1	6	C. & C. enclosed.
1	7½	Card, Multipolar.
1	7½	Jenney, Multipolar.

	H.P.	
1	7½	C. & C., Multipolar.
3	7½	Crocker-Wheeler.
1	7½	Eddy, Multipolar.
1	10	Phoenix, Multipolar.
1	10	Crocker-Wheeler.
1	10	Northern, Multipolar.
1	10	Triumph, Multipolar.
2	10	General Elec., Multipolar.
1	10	Perrett, Multipolar.
1	10	Eddy, Multipolar.
3	10	Belknap, Multipolar.
1	12	Am. Engine Co., Multipolar.
1	15	Eddy.
1	15	C. & C.
1	15	Edison.
1	15	Perrett, Multipolar.
1	15	Maine, Multipolar.
1	20	Eddy.
1	20	Perrett, Multipolar.
1	20	Holtzer-Cabot, Multipolar, enclosed.

ALTERNATING CURRENT MOTORS.

SINGLE PHASE. 125-133 CYCLES.

	H.P.	
2	¼	Stanley, 110 volts.
1	½	Holtzer-Cabot, 104 volts.
1	½	Emerson, 104 volts.
1	½	Wagner, 104 volts, automatic.
1	1	Fort Wayne, 104 volts.
1	1	Wagner, 208 volts, automatic.
1	1½	Wagner, 208 volts, automatic.
1	3½	Wagner, 110 volts, automatic.

THREE PHASE. 125-133 CYCLES.
For Monocyclic System.

	H.P.	
1	3	General Electric, 110 volts.

SINGLE PHASE. 60 CYCLES.

	H.P.	
1	½	General Electric, 110 v.
1	1	Phillips, 208 volts.
1	1	Phillips, 104 volts.
1	2	Wagner, 208 volts, automatic.
1	2	Wagner, 104 volts.
1	3	Wagner, 208 volts, automatic.
1	30	Wagner, 104 volts, automatic.

TWO PHASE. 60 CYCLE.

	H.P.	
1	2	General Electric, 220 volts.
1	5	Westinghouse, 220 volts.
1	50	Westinghouse, 400 v.
2	100	Westinghouse, 400 v.

THREE PHASE. 60 CYCLE.

	H.P.	
2	1	General Electric, 110 volts.
1	2	General Electric, 110 volts.
2	2	General Electric, 220 volts.
1	5	Gen. Elec., 110 volts.
1	10	Gen. Elec., 110 volts.
1	15	Gen. Elec., 110 v.
1	30	Gen. Elec., 110 v.

ELECTRIC LOCOMOTIVES.

	Ton.	
1	10	Morgan-Gardner, type M, 250 v. direct current, double motor locomotive, 74-K.W., 42-inch gauge, speed 6 to 10 miles per hour.
1	17	Morgan-Gardner, type N, 250 v., direct current, double motor locomotive, 115-K.W., 40-in. gauge, speed 8 miles per hour.

IMMEDIATE DELIVERY

ALTERNATING (60 Cycles

250-K.W. Westinghouse, 2 ph., 2200 v.
150-K.W. Stanley, 3 ph., composite.
100-K.W. G. E. monocyclic.
100-K.W. G. E., 3 ph., 2300 v.
50-K.W. G E., type A. S.
65-K.W. Stanley, 2 ph., composite.
100-H.P. Westinghouse, 3 ph., 550 v.
30-H.P. Westinghouse, 3 ph., 550 v.
15-H.P. Westinghouse, 3 ph.
100-H.P. type C, 2 ph., Westinghouse.
40, 30, 20, 15, 10 and 7½ Westinghouse.

ENGINES

20x36x48 Hewes & Phillips, c. c.
20x36x36 Buckeye tangye frame, t. c.
16x30x48 Hamilton Corliss, t. c.
15x26x17 McIntosh & Seymour, t. c.
16x28x16 Erie Ball, c. c.
13x23x17 (two) McIntosh & Seymour, t. c.
10x17x14 Ide, cross compound.
11x17x14 (two) Harrisburg, t. c.
20x27 Russell, 4 valve.

BOILERS

540-H.P. Sterling, 160 lbs.
66"x16' (two) h. r. t., 125 lbs.

Send for complete Bargain List of direct current Dynamos and Motors, Boilers, Engines, Transformers, etc.

JOSEPH H. THOMPSON, Jr., 11 Broadway, New York.

FOR SALE.

DIRECT CONNECTED.

500-Lt. Edison Dynamo, 110 volts, to Brotherhood engine.
10-K.W. Westinghouse dynamo to Armington & Sims engine, 110 volts.
10-K.W. Westinghouse dynamo to Westinghouse engine, 110 volts.
80-Amp. Edison dynamo, to Brotherhood engine, 80 volts.
20-H.P. Elektron, 220 volt motor to Morse-Williams freight elevator.

BELTED.

15-H.P. Herreshoff engine.
2000-Volt Electro Dynamic arc dynamo, 10 amperes.
500-Lt. Edison dynamo, 110 volts.
60-Amp. Westinghouse dynamo, 110 v.
35-Amp. Sprague dynamo, to Hornby-Ackroyd oil engine.
600-Lt. Weston dynamo, 110 volts.
400-Lt. Excelsior dynamo, 110 volts.
45-H.P. C. & C. motor, 230 volts.
15-H.P. Thomson-Houston motor, 500 volts with spare armature.
8-Gen. Elec., 2-H.P. 220 volt motors.
8-Siemens & Halske 5-H.P. 220 volt motors, enclosed waterproof.
2 searchlights.
8—5-H.P. Cutler Hammer 220 volt, series wound reversible controllers.
1—2½x4 Laidlaw-Dunn-Gordon 3 plunge power pump.
3—Thomson Wattmeters, 450 amp. 125 v.

Large stock of smaller dynamos and motors.

Repairing of electrical machinery in all its branches.

Write for our list of motors and dynamos or visit our shop, where the above mentioned machinery can be seen.

JORDAN BROS., 74 Beekman St., N. Y.

DYNAMOS ENGINES BOILERS

SEND FOR LATEST CATALOGUE--JUST OUT

ROSSITER, MacGOVERN & CO.,

17 BATTERY PLACE, NEW YORK

Branch Offices: 84 State St., Boston Compton Ave., St. Louis

MOTORS PUMPS CONDENSER

BARGAINS

Alternating and direct-current Motors, Dynamos, at bargain prices. Send in your requirements and we will be pleased to quote you. Lot of A. C. and D. C. Desk and Ceiling Fans cheap.

EUGENE L. RICHTER
1914 Columbia Ave.
PHILADELPHIA, PA.

FOR SALE

About 100 New England Butt Co.'s double insulating machines for insulating wire; in good order, some almost new; also a Payne spooler.

NEWTON I. STEERS, 128 Maiden Lane, N.Y.

FOR SALE

One Waverly Electric Runabout and several small Gas and Gasoline Engines :: :: :: ::

W. F. WARNER
MUNCIE, IND.

A. J. RUEL
ELECTRICAL MACHINERY
Bought and Sold
NORTH ADAMS, MASS.

FOR SALE

An electric light plant in central New York, street lighting contract and good business established. For particulars address No. 1614, care Electrical World and Engineer, New York.

READY TO SHIP

ALTERNATORS.

1—300-K.W. 60 cycle, two-phase Stanley, direct connected.
1—300-K.W. 60 cycle General Electric, direct connected.
2—120-K.W. 60 cycle General Electric, single phase.
1—120-K.W. 60 cycle Westinghouse, 2 phase.
1—100-K.W. 60 cycle General Electric, 3 phase.

ENGINES.

16&30x48 Cooper Cross-compound Corliss, complete with Independent Condenser.
24x42 Atlas Corliss.
22x48 Allis Rope Drive.
22x42 Heavy Duty Hamilton Corliss.
24x20 Ideal, latest type.
200-H.P. Brand New American Ball, 18x16.

Send for list No. 42 of Dynamos, Engines and Boilers.

STATION EQUIPMENT COMPANY, 204 DEARBORN ST. CHICAGO.

For Sale—Four 22' and 42' x 48'

Hamilton Tandem Compound Condensing Corliss Engines

With Independent Condenser for Each. Wheels: 24 ft. x 50 ins., 60,000 lbs. Capacity: 750 to 1,000 H.P. Each. Located in New York City.

900-H.P. 34x60 International Power Corliss.
450-H.P. 16 and 30x42 Allis Compound Corliss.
450-H.P. 24x48 Brown Corliss.
400-H.P. 23x60 Geo. H. Corliss.
300-H.P. 20x48 Harris Corliss.
275-H.P. 20x42 Hamilton Corliss Engine.
225-H.P. 18x42 Hamilton Corliss.
200-H.P. 18x36 Bates Corliss.
200-H.P. 12 and 22x42 Atlas Compound Corliss.
175-H.P. 16x42 Allis Corliss.
150-H.P. 15x38 Brown Corliss.
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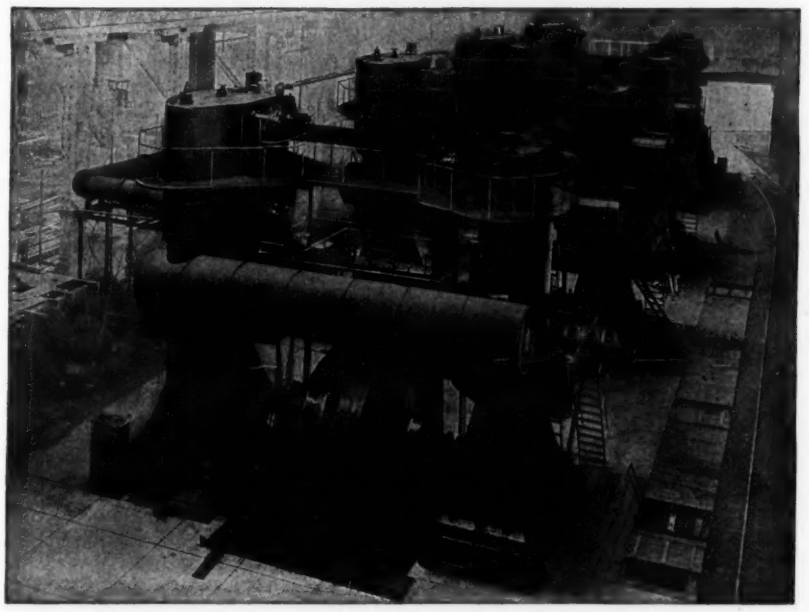

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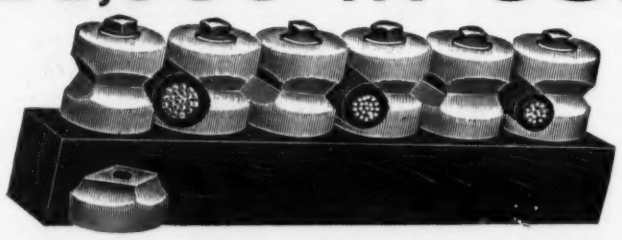

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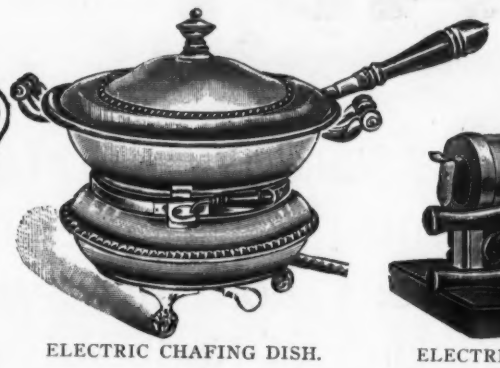

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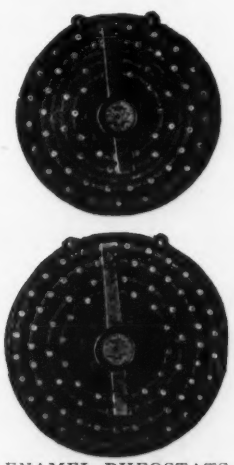

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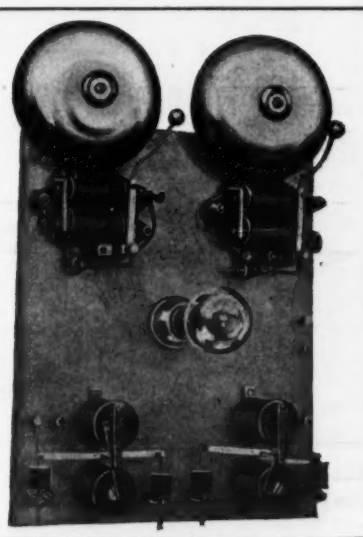

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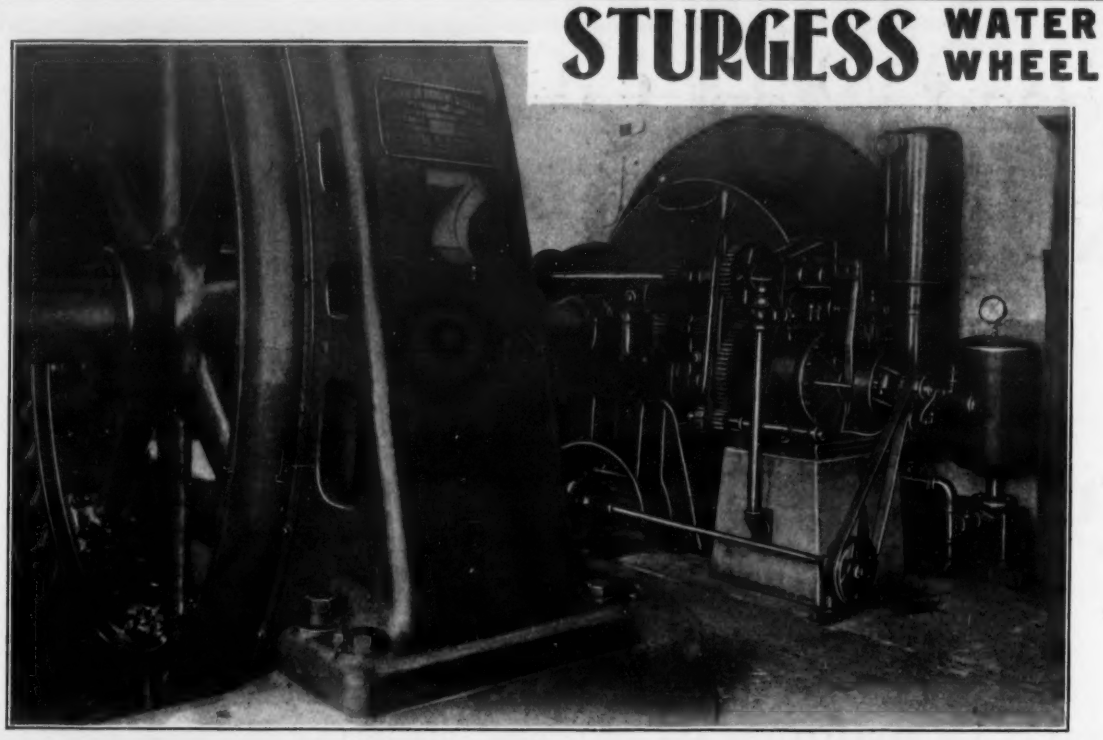

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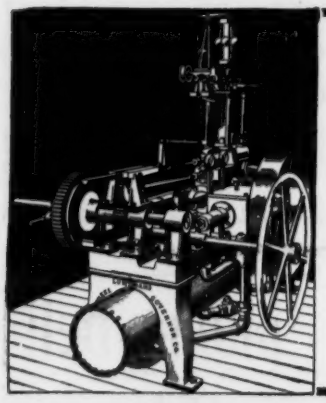

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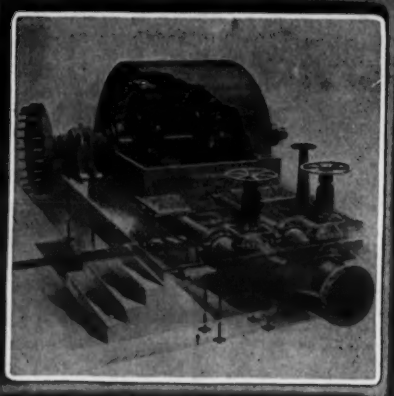

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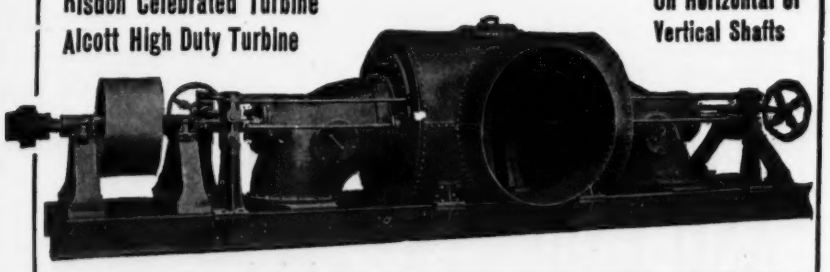

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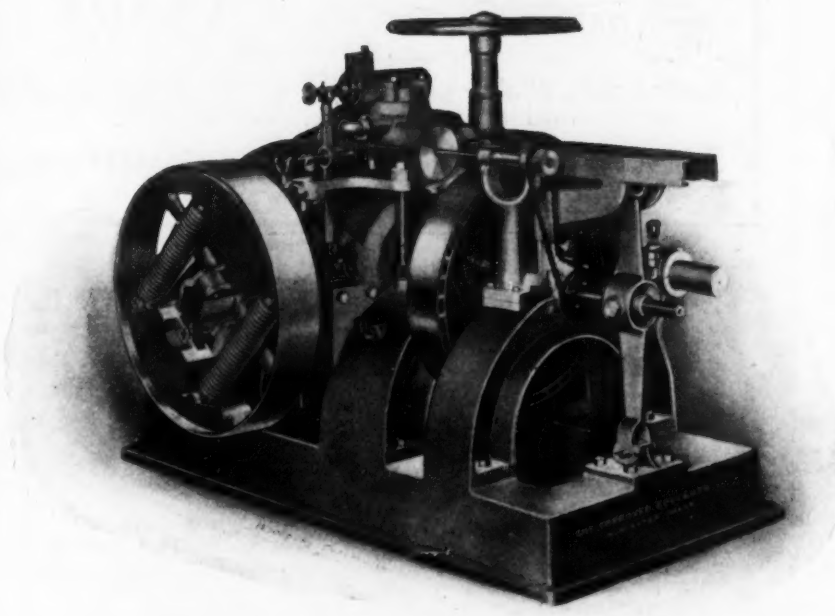

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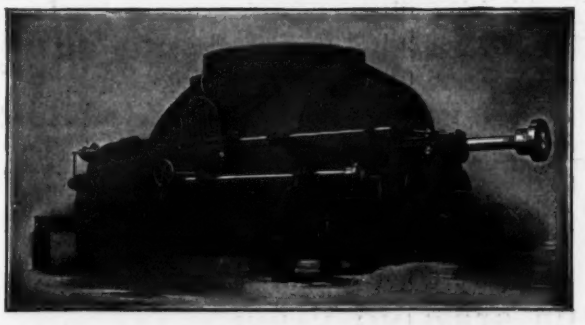

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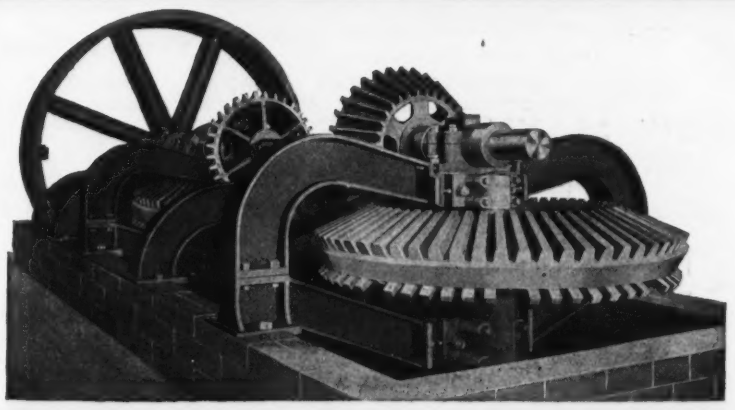

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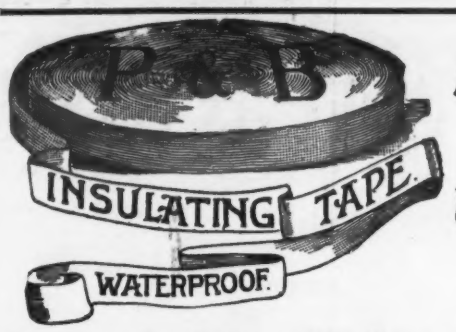

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